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No. 03-1413  
(Serial No. 08/950,445)

U.S. PATENT & TRADEMARK OFFICE

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**UNITED STATES COURT OF APPEALS**  
**for the Federal Circuit**

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In re Joseph B. Kejha

APPEAL FROM THE UNITED STATES PATENT AND TRADEMARK  
OFFICE, BOARD OF PATENT APPEALS AND INTERFERENCES

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**BRIEF OF APPELLANT, JOSEPH B. KEJHA**

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July 28, 2003

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UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

In re Joseph B. Kejha

No. 03-1413  
(Serial No. 08/950,445)

**CERTIFICATE OF INTEREST**

Counsel for appellant certifies the following:

1. The full name of every party or amicus represented by me is:

Joseph B. Kejha

2. The name of the real party in interest (if the party named in the caption is not the real party in interest) represented by me is:

none

3. All parent corporations and any publicly held companies that own 10 percent or more of the stock of the party or amicus curiae represented by me are:

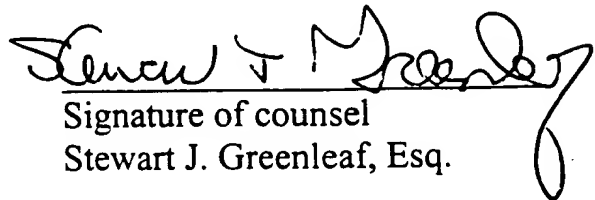
none

4. ☐ There is no such corporation as listed in paragraph 3.

5. The names of all law firms and the partners or associates that appeared for the party or amicus now represented by me in the trial court or agency or are expected to appear in this court are:

Stewart J. Greenleaf, Esquire

July 28, 2003

  
Signature of counsel  
Stewart J. Greenleaf, Esq.

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## STATEMENT OF RELATED CASES

The present patent application P1, A20, has not previously been before this Court. Inventor has another subsequent patent application P2 presently pending before the PTO for a hydrogen electric hybrid vehicle which is a continuation of P1. P2 was filed on July 9, 1999, and given application Ser. no. 09/350,713. P2 is presently being reviewed by an examiner.

The two patent applications are different in that P1 involves a two wheeled vehicle and sets forth as a specification, long distance non-polluting performance, while P2 is a vehicle with two or more wheels and specifically claims long distance non-polluting performance as part of the patent application.

## **STATEMENT OF SUBJECT MATTER AND APPELLATE JURISDICTION**

The PTO has subject matter jurisdiction of the Patent application of Appellant-Inventor pursuant to 35 U.S.C. §§1, 6 and 7 et seq. This Court has appellate jurisdiction to review the decisions of ". . . the Board of Patent Appeals and Interferences of the Patent and Trademark Office with respect to patent applications, at the instance of an applicant for a patent." 28 U.S.C. §1295(a)(4)(A).

The Board of Patent Appeals and Interferences issued a final decision affirming the decision of the Examiner denying the application for a Patent on February 24, 2003. A1. Thereafter, Inventor filed a timely Notice of Appeal with the PTO on April 19, 2003. A18 line 31.

## STATEMENT OF ISSUES

Whether the Board erred as a matter of law when it failed to grant the subject patent under 35 U.S.C. §103(a) and used hindsight to determine obviousness when the patent application was nonobvious, and further failed to take into consideration secondary considerations which this invention produced such as new and unexpected results and fulfilled a long felt and unresolved need where others have failed.

## STATEMENT OF THE CASE

This is an appeal from the final decision of the Board of Patent Appeals and Interferences rejecting claims 10-12 on February 24, 2003, A1, being all the claims in the case.

This application, subject to this appeal, was filed on October 15, 1997, A20, as a continuation in part of Application Serial No. 08/373,090 filed January 17, 1995 (now abandoned), which is related to a prior co-pending Disclosure Document of Joseph B. Kejha, Serial No. 322,973 filed on January 12, 1993. Per Examiner's action on April 13, 1999, A115, Inventor elected, on May 5, 1999, a restriction of this application to Species II, claims 10-12, drawn to a vehicle powered by a hydrogen fueled engine. A119.<sup>1</sup>

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<sup>1</sup>At the direction of the PTO under 35 U.S.C. § 121, Election/Restriction, A115, the Inventor's patent application was grouped into Species I, II, III and IV. A117, 118. The subject matter of this appeal claims 10-12 were grouped under Species II. A119. On March 27, 2000, Inventor filed a continuation in part of this application, restricted to Species I, claims 1-9, 13-14, and 28-34, drawn to an electrically powered cycle, No. 09/535,193. A206.

Inventor filed on September 29, 2000, a continuation in part of this Application, restricted to Species III, claims 24-25, drawn to a vehicle with parallel battery chargers, No. 09/675,377. A206. Species I and III have been abandoned.

Inventor will file a continuation in part of this Application, restricted to Species IV, claims 15, 26-27, drawn to a vehicle frame formed from a magnesium alloy. A207.

Claims 1-9 and 13-33, which are all of the other claims pending in this application, have been withdrawn from consideration. The only claims rejected by the Examiner, considered by the Board and before this Court are claims 10-12. A195.

Four claims (10, 11, 12 and 34 dependent on claims 10-12) of this application were rejected on July 12, 1999, A121, and an amendment was filed on October 12, 1999, which canceled claim 34 and amended claims 10-12. A138. The claims 10-12 were rejected on December 27, 1999. A161.

Inventor on March 25, 2000, sent a Notice of Appeal to the Board of Appeals requesting that the Board review the Examiner's decision of rejecting claims 10-12. A18 line 11. There were no claims objected to or allowed and 34 claims were canceled. The claims were rejected by the Examiner under 35 U.S.C. § 112, the basis of the rejection was subsequently withdrawn by the Examiner on December 28, 1999. A18 line 10, A163. On that date, claims 10-12 were again rejected by the Examiner under 35 U.S.C. § 103 as obvious over West No. 3,517,766, Laumann No. 4,112,875, Thomson No. 3,554,311, and Munday No. 5,142,125. A18 line 10, A163. On May 23, 2000, Inventor appealed the final rejection of claims 10-12, and filed a Brief of Appellant (Inventor). A18 line 12. On November 15, 2000, as a result of the arguments set forth in Inventor's brief, the Examiner reconsidered the final rejection of the above claims and decided to reopen the prosecution of the application. However, the Examiner rejected claims 10-12 again under 35 U.S.C. § 103(a) in view of Minami et al (US 5,462,021), West (US 3,517,766) and Munday (US 5,143,125). A171.

Inventor filed an Amendment on March 14, 2001, with a Petition for Extension



of time of one month, defending the claims 10-12. A180. Inventor received a Notice of Non-Compliant Amendment of March 26, 2001, A189, and responded with letter and corrections on April 25, 2001. A192. The claims were finally rejected by the Examiner on July 16, 2001. A195.

Inventor, on October 10, 2001, again sent a Notice of Appeal to the Board of Appeals. A18 line 22. Oral argument was heard on February 4, 2003, by the Board, A18 line 28, after which it issued its decision on February 24, 2003, affirming the decision of the Examiner rejecting claims 10-12. A1.

The Board held in its Conclusion on page A14 as follows:

To summarize, the decision of the examiner to reject claim 10 under 35 U.S.C. § 103 as being unpatentable over West in view of Minami is reversed and the decision of the examiner to reject claims 10 to 12 under 35 U.S.C. § 103 as being unpatentable over West in view of Munday is affirmed.

Since at least one rejection of each of the appealed claims has been affirmed the decision of the examiner is affirmed.

On April 19, 2003, the Inventor filed a timely Notice of Appeal with the PTO and this Court. A18 line 31. Hence this appeal.

## **STATEMENT OF THE FACTS**

The invention consists of a hydrogen fueled electric hybrid vehicle, which has a long range while being non-polluting.

Inventor's claims 10-12 do not stand or fall together and are summarized as follows:

10. Electric vehicle construction which includes a body for carrying at least one passenger and an electric propulsion system with at least one electric motor, at least one battery, at least one electric current generator for charging said battery and which is driven by an internal combustion engine, and a hydrogen storage system having hydrogen therein attached to said body, and which body rides on two wheels with a steering system attached to said body, the improvement wherein said engine is an open to air combustion engine and is fueled only by said hydrogen. A56-60.

11. Electric vehicle construction which includes a body for carrying at least one passenger and an electric propulsion system with at least one motor, at least one battery, at least one electric current generator for charging said battery and which is driven by an internal combustion engine, and a hydrogen generating cell attached to said body, and which body rides on two wheels with a steering system attached to said body, the improvement wherein said engine is an open to air combustion engine and is fueled only by hydrogen which is produced by electrolysis of water in said hydrogen generating cell, said cell is electrically connected to said generator and also to said battery, the hydrogen is not stored under pressure and is immediately consumed by said engine. A60.

12. Electric vehicle construction which includes a body for carrying at least one passenger and an electric

propulsion system with at least one electric motor, at least one battery, at least one electric current generator for charging said battery and which is driven by an internal combustion engine, a hydrogen storage system having hydrogen therein and a hydrogen generating cell which generates hydrogen by electrolysis of water, the improvement wherein said engine is an open to air combustion engine and is fueled only by hydrogen, the hydrogen being supplied from said storage system and from said hydrogen generating cell, said cell is electrically connected to said generator, and said cell is also electrically connected to said battery.  
A60-61.

There is a great advantage in the Inventor's use of an electric hybrid vehicle (with batteries), which is fueled by hydrogen, because the combustion engine required for an electric hybrid vehicle is approximately one third the size required for a combustion-only driven vehicle. That means, the electric hybrid has approximately three times longer range per the same amount of hydrogen. Because compressed hydrogen, or in a metal hydride storage tank is very bulky and/or heavy, and hydrogen fueled combustion-only vehicles have a very limited and short range, similar to electric-only vehicles. The electric-hybrid vehicle configuration fueled by hydrogen makes the hydrogen-electric vehicle of the invention competitive in the range with gasoline fueled, combustion-only vehicles, and is non-polluting. It should be noted, that the negligible amounts of nitrogen oxides generated by these vehicles can be captured by any well known catalytic converter. A47-48. The range limitation of the hydrogen fueled, combustion-only, large engine vehicle is now overcome by

Inventor's hydrogen fueled electric hybrid vehicle, with a small internal combustion engine/generator, and an electric motor with batteries. It is also a cost effective alternative to fuel cell vehicles, which are today's common proposal, and this alternative will not deplete the world's supply of platinum. A210. The fueling of the electric hybrid vehicle with non-polluting hydrogen gas may be done on demand only for safety, by electrolysis of water carried in the vehicle, or the hydrogen may be stored in a tank, which may contain a metal hydride, or the hydrogen may be supplied from both. A48.

Preferred embodiments of the invention are illustrated in the following example. Referring now in more detail, particularly to the drawings of this patent application and Figures 1, 2, 3 and 6 which shows a two wheeled and steered hydrogen-electric hybrid vehicle and its systems. A79, 80, 82.

The propulsion system comprises, at least one electric motor 31 behind the seat 6, which may preferably have a copper disc clutch 200 (which may be controlled by the driver by well known means), and a reduction drive 32 preferably driving a larger rear wheel 4 through a timing belt 33, and pulleys 33A and 33B. At least one battery or batteries 96 and 97, are preferably mounted under the seat 6, or on both sides of the rear wheel 4 (not shown), to keep the center of gravity of the vehicle low. The clutch 200 protects the motor and the batteries from an electric surge load during acceleration from standing or other shocks, and the copper material provides long wear life. The

electric motor may be controlled by a variable speed controller 27, attached to the foot rest platform 8, or it may be attached to the motor 31 (not shown), or to other components. An accelerator which is electrically connected to the controller 27, may be a potentiometer 34 turned by a cable from a "wrist-twist" of the handle 14. There is no "shifting" of speeds involved. Other electrical components like electronic boards, relays, breakers, switches, fuses and distribution blocks (not shown) may be mounted in an electrical box 38, preferably behind the seat.

In addition to this "electric-only" drive, there is optionally provided at least one additional power system, comprising a small open to air internal combustion engine 87, as shown in Fig. 6, which may be a piston type reciprocating engine, rotary piston type, or a turbine, which is driving an electric current generator 104, which may be an alternator with a rectifier and voltage regulator for charging the batteries 96 and 97. The generator 104 may replace the engine flywheel to reduce the total weight, and may have a clutch 250 to enable the engine to start without the generator load. This results in a smaller, lighter and less fuel consuming engine. The engine/generator unit may be mounted on a rack or shelf 35, behind the driver's seat 6 and above the rear wheel 4, and may be enclosed by an aerodynamic end cover enclosure 37. The shelf 35 is supported by braces 36 and 36A. The aerodynamic end cover enclosure 37 may be sound-proofed to reduce the engine noise. It is preferred to have the engine on the very end of the vehicle for the same reason, and because the engine is usually lighter

than the generator. This additional power back-up system provides for an electric-hybrid vehicle and serves as a mileage extender, or as a main cruising power supply, with batteries used only for acceleration and extra power for hill climbing. The generator should be designed for cruising power, plus extra for charging the batteries during level cruising, and for other loads. However, it is possible to drive this vehicle a shorter distance only on battery power, as a "stealth" vehicle.

To make this engine or turbine non-polluting, it should preferably be fueled by hydrogen, contained in the tank 103, which may also contain a metal hydride of well known type. Since the use of hydrogen as a fuel requires precautions, it may be produced on demand only for safety reasons, by electrolysis of water, which may be produced by action of the electric current generator 104, or the hydrogen may be produced by other sources.

If electrolysis of water is used, then the hydrogen tank 103 may be replaced, (or assisted), by a hydrogen generating cell 105 of well known type, which may be electrically connected to the generator 104. The water may have also an antifreeze agent added thereto.

The hydrogen generating cell 105 may also be electrically connected to a battery 109, and/or to the batteries 96 and 97, to start the system operating and also for vehicle acceleration when the demand for fuel is high. The batteries may be recharged by the generator 104 during low power cruising or standing.

A simplified schematic diagram illustrating the principles of the system is shown in Fig. 6, which is another embodiment of the invention. Switches or relays 110, 111, 112, 115 and 116 and valve 113 control the system functions as desired.

Referring now to Fig. 6, A82, in more detail, the simplified operation of the system is as follows:

To start the engine 87, the switch 111 or switch 116 is turned "ON", which delivers direct electric current from the battery 109, or from the batteries 96 and 97 (if they still have some electric energy stored in them), to the hydrogen-oxygen generating cell 105, which produces hydrogen and oxygen gases and the gases, are delivered into the combustion chamber of the engine 87. The engine 87 is simultaneously cranked either manually, or by its own cranking battery with a starter (not shown). When the hydrogen fuel and air, plus oxygen are being delivered into the engine, the engine starts running and also driving the generator 104. When the switch 110 is turned "ON", the direct electric current from the generator 104 is delivered to the cell 105 and adds to, or replaces the current from the batteries 109, or 96 and 97. The switches 111 and/or 116 may then be turned "OFF", which will disconnect the batteries from the cell 105.

If it is desired that the cell 105 is to be used to assist only in delivery of the fuel, then the engine 87 may be started as follows: During cranking of the engine 87, all the switches shown are turned "OFF", but the valve 113 is opened, which delivers

stored hydrogen fuel from the tank 103 into the combustion chamber of the engine 87, and the engine starts running and driving the generator 104. When the switch 110 is turned "ON", the electric current is delivered to the cell 105, which starts producing hydrogen and oxygen gases, and these gases are delivered into the engine 87, supplementing or replacing the hydrogen fuel from the tank 103. The valve 113 may then be closed. The batteries 109, 96, and 97 may also be recharged by the generator 104 when the switches 115 and 112 are turned "ON".

All the above described functions can be automated and controlled by an electronic controller (not shown), and all the switches may be replaced by relays.

All the "negative" or all the "positive" wires may be replaced by an electrically conductive frame or chassis.

In the prior art of West, A87, an electric hybrid vehicle has been proposed to increase the battery range, but the non-electric portion with a petroleum powered engine is not free from atmospheric pollution.

In Munday, A102, a vehicle is shown which uses an internal combustion engine fueled by hydrogen, which is produced from electrolysis of water powered by a battery. The vehicle is non-polluting, but has a short range due to a large engine, which is required for all combustion only vehicles. The range is further decreased by a large and heavy battery which is required as the only source of electricity for the production of hydrogen.



## SUMMARY OF ARGUMENT

The Board failed to establish obviousness, by selecting individual functions from the prior art, then slipped into hindsight evaluation when the prior art did not suggest as a whole the present invention and completely failed and refused to consider any secondary considerations.

## ARGUMENT

### **I. INVENTOR'S CLAIMS ARE NOT OBVIOUS. THE BOARD HAS FAILED TO ESTABLISH OBVIOUSNESS BY FAILING TO MAKE SUFFICIENT FACTUAL FINDINGS AS REQUIRED BY STATUTORY AND CASE LAW.**

#### **i) Standard of Review**

The standard of review when considering factual findings of obviousness is substantial evidence. Questions of law are reviewed without deference, de novo. Dickinson v. Zurko, 527 U.S. 150, 144 L.Ed.2d 143, 119 S.Ct. 1816 (1999).

The claimed invention is unpatentable for obviousness if the differences between it and the prior art "are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art." 35 U.S.C. §103(a); In re Zurko, 258 F.3d 1379 (Fed. Cir. 2001).

This Court has held on numerous occasions that obviousness is a legal question based on underlying factual determinations including: (1) the scope and content of the prior art, including what that prior art teaches explicitly and inherently; (2) the level of ordinary skill in the prior art; (3) the differences between the claimed

invention and the prior art; and (4) objective evidence of nonobviousness. Graham v. John Deere Co., 383 U.S. 1, 17-18, 152 L.Ed.2d 545, 86 S.Ct. 684 (1966).

This Court reviews the ultimate legal determination of obviousness without deference and factual findings underlying this determination for substantial evidence. In re Gartside, 203 F.3d 1305, 1311-16 (Fed. Cir. 2000); In re Zurko, 258 F.3d 1379 (Fed. Cir. 2001).

The Administrative Procedure Act (APA), 5 U.S.C. §706, originally enacted in 1946, sets forth standards that govern the scope of court review. It says that a reviewing court shall hold unlawful and set aside agency findings found to be unsupported by substantial evidence. In making these determinations, the court reviews the whole record. Substantial evidence is defined as ". . . such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." Dickinson v. Zurko, *supra*, Consolidated Edison Co. v. NLRB, 305 U.S. 197, 229, 83 L.Ed. 126, 59 S.Ct. 206 (1938). The APA requires meaningful review; and its enactment meant stricter judicial review of agency fact finding than Congress believed some courts had previously conducted. Dickinson v. Zurko, *supra*.

Therefore, this Court is obliged in accordance with the above standard of review to set aside legal actions of the PTO that are arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law, and set aside factual findings, as in the present case, that are unsupported by substantial evidence. Mazzari v. Rogan,

323 F.3d 1000 (Fed. Cir. 2003), In re McDaniel, 293 F.3d 1379, (Fed. Cir. 2002).

**ii) Obviousness, Pick and Choose**

The pertinent statute, 35 U.S.C. §103(a) provides as follows:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Obviousness, under 35 U.S.C. §103 (a), is a question of law that the Court reviews de novo to determine from the facts. In re Donaldson Co., Inc., 16 F.3d 1189 (Fed. Cir. 1994). The obviousness determination is based on underlying factual inquiries concerning the claimed invention and the prior art, which are reviewed for substantial evidence. However, it is the ultimate conclusion of obviousness that this Court reviews as a matter of law. In re DeBlauve, 736 F.2d 699, 703 (Fed. Cir. 1984).

In proceedings before the PTO, the examiner bears the burden of establishing a prima facie case of obviousness based upon the prior art. The examiner can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references. When the PTO shows prima facie obviousness, the burden shifts to the inventor to rebut. The inventor may

then attack the examiner's prima facie determination as improperly made out, or the inventor may present objective evidence tending to support a conclusion of nonobviousness.

Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination. Under 35 U.S.C. §103(a), teachings of references can be combined only if there is some suggestion or incentive to do so. Although couched in terms of combining teachings found in the prior art, the same inquiry must be carried out in the context of a purported obvious "modification" of the prior art.

When a rejection depends on a combination of prior art references, there must be some teaching, suggestion, or motivation to combine the references. In re Rouffet, 149 F.3d 1350 (Fed. Cir. 1998), In re Beattie, 974 F.2d 1309, 1311-12 (Fed. Cir. 1992), In re Geiger, 815 F.2d 686, 688 (Fed. Cir. 1987), In re Nomiya, 509 F.2d 566 (CCPA 1975). This Court held in In re Rouffet, supra, that the Board must describe the basis for its decision and specifically identify the principle, known to one of ordinary skill, that suggests the claimed combination.

On page 1359 this Court in In re Rouffet, supra, held:

. . . As this Court has often noted, invention itself is the process of combining prior art in a nonobvious manner . . . the Board must identify specifically the principal, known to one of ordinary skill, that suggests the claimed combination.

. . . explaining that the Board's opinion must describe the basis for

its decision. In other words, the Board must explain the reasons one of ordinary skill in the art would have been motivated to select the references and to combine them to render the claimed invention obvious.

This Court went on to hold that every invention has prior art elements, and the Board may not use the claimed invention itself as a blueprint to put together elements of the prior art to defeat the claimed invention.

Obviousness is determined from the vantage point of a hypothetical person having ordinary skill in the art to which the patent pertains. See 35 U.S.C. §103(a). This legal construct is akin to the "reasonable person" used as a reference in negligence determinations. The legal construct also presumes that all prior art references in the field of the invention are available to this hypothetical skilled artisan. See In re Carlson, 983 F.2d 1032, 1038 (Fed. Cir. 1993).

As this court has stated, "virtually all [inventions] are combinations of old elements." Environmental Designs, Ltd. v. Union Oil Co., 713 F.2d 693, 698 (Fed. Cir. 1983); see also Richdel, Inc. v. Sunspool Corp., 714 F.2d 1573, 1579-80, (Fed. Cir. 1983) ("Most, if not all, inventions are combinations and mostly of old elements."). Therefore an examiner may often find every element of a claimed invention in the prior art. If identification of each claimed element in the prior art were sufficient to negate patentability, very few patents would ever issue. Furthermore, rejecting patents solely by finding prior art corollaries for the claimed elements would permit an examiner to use the claimed invention itself as a blueprint for piecing together elements in the prior art to defeat the patentability of the claimed invention. Such an approach would be "an illogical and inappropriate process by which to determine patentability." Sensonics, Inc. v. Aerosonic Corp., 81 F.3d 1566, 1570 (Fed. Cir. 1996).

To prevent the use of hindsight based on the invention to defeat patentability of the invention, this court requires the examiner to show a motivation to combine the references that create the

case of obviousness. In other words, the examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed.

Where the Board does not explain the specific understanding or principal within the knowledge of a skilled artisan that would motivate one with no knowledge of a patent applicant's invention to make the combination, the courts infer that the examiner selected the references with the assistance of hindsight. The courts forbid the use of hindsight in the selection of references that comprise the case of obviousness.

The Board must identify specifically the principle, known to one of ordinary skill, that suggests the claimed combination. In other words, the Board must explain the reasons one of ordinary skill in the art would have been motivated to select the references and to combine them to render the claimed invention obvious. In re Rouffet, supra.

The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification. It is impermissible to use the claimed invention as an instruction manual or template to piece together the teachings of the prior art so that the claimed invention is rendered obvious. This Court has previously stated that one cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to defeat the claimed invention. In re Fritch, 972 F.2d 1260, 1266 (Fed. Cir. 1992).

Here, the Board went through a process of "picking and choosing" from the elements of the prior art to reconstruct the present claim. Bausch & Lomb, Inc. v.

Barnes Hind Hydrocurve, Inc., 796 F.2d 443 (Fed. Cir. 1986).

This Court has held that the Board may not present an "obvious to experiment" standard in order to establish obviousness. In re Dow Chemical Co., 837 F.2d 469 (Fed. Cir. 1988). An "obvious-to-try" situation exists when a general disclosure may pique the scientist's curiosity, such that further investigation might be done as a result of the disclosure, but the disclosure itself does not contain a sufficient teaching of how to obtain the desired result, or that the claimed result would be obtained if certain directions were pursued. This Court has held that "obvious-to-try" is not to be equated with obviousness. Gillette v. Johnson, 919 F.2d 720 (Fed. Cir. 1990).

This Court in In re Chu, 66 F.3d 292 (Fed. Cir. 1995), reversed the Board on their decision of obviousness. It held that in a proper obviousness determination, regardless of whether the changes from the prior art are minor, the changes must be evaluated in terms of the whole invention. This includes what could be characterized as simple changes.

Although a prior art device could have been turned upside down, that did not make the modification obvious unless the prior art fairly suggested the desirability of turning the device upside down. In re Gordon, 733 F.2d 900, 902 (Fed. Cir. 1984).

Here, the Board simply took the "fueled by hydrogen" and "reduce pollution" elements of Munday and then "modified West's electric vehicle" by those elements. A12-13. The Board completely failed to describe the basis for its decision or any

reasons why one of ordinary skill in the art would have been motivated to select those references and to combine them to render the claimed invention obvious. The Board has failed to suggest any motivation for, or desirability of, the changes espoused by the Examiner and endorsed by the Board. The prior art made no suggestion that combining the electric hybrid vehicle of West and substituting the gasoline fuel system with the hydrogen fuel system of Munday would have resulted in a vehicle that produced long range and other energy saving functions.

More specifically, the Board's rejection of claim 10 is in error. A16a, 16b. The West patent, A87, discloses an electric hybrid vehicle, which is using a polluting gasoline engine with generators and a battery powered electric motor to propel the vehicle. A87, 93. However, West does not suggest that this vehicle is fueled by non-polluting hydrogen. Inventor's hydrogen electric hybrid vehicle, as described, makes the vehicle competitive in regard to range with polluting conventional gasoline-only vehicles, but is non-polluting. A47, 48. Inventor asserts that the Board combination of references is improper. Moreover, nothing in the references cited by the Board suggests Inventor's claim.

The Board's rejection of claim 11, A16a, 16b, as being unpatentable over prior art patents of West and Munday is in error. Inventor asserts that claim 11 is patentable as was discussed for claim 10, and additionally over the patent to Munday on the ground, that none of them even remotely suggests the combination or system of



Inventor, as claimed in 11, or that they can be selectively combined. As the Examiner stated, West fails to teach an engine being fueled by hydrogen obtained from an electrolysis device, which is electrically connected to the generator and battery. A174, 175. Munday describes an electrolysis apparatus for fueling an engine, but does not teach an electric hybrid vehicle. A102, 110. West does not have the electrolysis device, A87, 93, and Munday does not have the electric generator, and electric motor. A102, 110. Munday does not have a "hydrogen storage element" 16, as the Examiner stated. A175. It is a hydrogen generating cell housing. A 103. The cell uses only a battery, A112, which battery would have to be so large and heavy, thus further limiting the vehicle range, that it would be impractical.

The rejection of claim 12, A16a, 16b, by the Board as being unpatentable over West and Munday is also in error. Inventor asserts that claim 12 is patentable as discussed in claims 10 and 11 and additionally over the patent of Munday on the grounds that it does not even remotely suggest the combination or the system of Inventor, as claimed in claim 12, or that they can be selectively combined. West fails to teach an engine being fueled by hydrogen from any source. A87, 93. Munday fails to teach a hybrid electric vehicle. A102, 116. Furthermore, Munday does not disclose a separate hydrogen storage tank for supplying hydrogen to the hydrogen electric hybrid system of Inventor, in parallel with the electrolysis apparatus, as described in Inventor's specification, A48 lines 9-12, and as claimed in claim 12.

In combining references, the Board did not and could not find any suggestion of desirability of the proposed combination, find any suggestion for combining the references in the references themselves, nor find any suggestion in the references taken as a whole of the structure claimed. Although Munday suggests the well known desirability of hydrogen fuel for lower emissions, A110, it fails to suggest the desirability of Inventor's combinations for overcoming the short range of his hydrogen fueled vehicle. A27, 47, 48, 67. His teaching does not lead nor suggest to those of ordinary skill in the art Inventor's desirable and unexpected result. Inventor's electric hybrid vehicle fueled by hydrogen is quite different from all of the references cited by the Board. A198.

At no point in the references is an electric hybrid vehicle mentioned, which is fueled by hydrogen. The Board's hindsight reasoning is merely an invitation to experiment.

In response to the Examiner's prior conclusion of obviousness based on "common knowledge" and "common sense," A168, it should be realized that most inventions look "obvious" after they are disclosed. Any known device can be selectively connected to any known device, but to select the right combination and to create an original and desirable feature requires vision, imagination and inventiveness. Inventor's three inventions as claimed cannot be found on the record, as proposed, suggested or reduced to practice, before the time of the Inventor's invention on

January 12, 1993. A28.

The Board failed to recognize that the Inventor's hydrogen electric hybrid vehicle is made not only for the purpose of the desirability of clean emissions, which feature of hydrogen fuel is well known, but mainly for extending the hydrogen fueled vehicle range, so it can be competitive with gasoline combustion-only vehicles. A47, 48. This is the desirable and unexpected result, which is not suggested in any way in the Board's references, nor is it suggested anywhere on the record before the time of the Inventor's invention.

Prior art electric hybrid vehicles, such as West's vehicle were made only for the purpose of extending the range of electric-only vehicle, A93, not to extend the range of hydrogen fueled, combustion-only vehicle.

Therefore, no one suggested or disclosed on the record before the time of the invention, that the short range of a hydrogen fueled combustion-only vehicle under Species (restriction) II, A117, can be overcome by an electric hybrid configuration, as described in the Inventor's specification. A47, 48, line 1. The short range of hydrogen fueled combustion-only vehicles is the main obstacle preventing their widespread use. A47.

The Board has not satisfied its burden and shown any objective teachings in the prior art, specifically West and Munday, which would lead one of ordinary skill in the art to make a non-polluting, long range electric hybrid vehicle with batteries, and

art references. A175. There was confusion because he was using hindsight. The Board reversed the Examiner " . . . as being unpatentable over West in view of Minami . . . " and affirmed his rejection of " . . . claims 10 to 12 under 35 U.S.C. §103 as being unpatentable over West in view of Munday is affirmed." A14.

A review of the above prosecution history appears to indicate that the Examiner prejudged obviousness, and then began a search for statutory and prior art references to support his position.

In Graham v. John Deere Co., *supra*, the Supreme Court elaborated on the procedure for determining whether an invention would have been obvious within the meaning of 35 U.S.C. §103(a). The case instructs courts to make three factual inquiries and to weigh other objective evidence as a predicate to the ultimate determination of law. See also In re Rouffet, *supra*, 1355, where this Court applied these factual findings to a case appealed from the Board and reversed on obviousness.

It is clear that a fact finder must make Graham findings before invalidating a patent for obviousness. The use of Graham findings helps to prevent the Board from slipping into hindsight evaluation. The Board need not mention Graham, but it is reversible error if the required factual determinations were not made. Ruiz v. A. B. Chance Co., 234 F.3d 654, 663-667 (Fed. Cir. 2000).

The Board did not conduct a proper analysis of the facts for obviousness, since it improperly focused on a combination of old elements, ignored secondary evidence

of nonobviousness and failed to make sufficient Graham findings. A12, 13, 14. Custom Accessories, Inc. v. Jeffrey-Allan Industries, Inc., 807 F.2d 955, 958-959 (Fed. Cir. 1986).

## **II. THE BOARD FAILED AND REFUSED TO CONSIDER ANY SECONDARY CONSIDERATIONS**

To reject claims in a patent application under 35 U.S.C. §103, an examiner must show an unrebutted prima facie case of obviousness. In the absence of a proper prima facie case of obviousness, an applicant who complies with the other statutory requirements is entitled to a patent. On appeal to the Board, an applicant can overcome a rejection by showing insufficient evidence of prima facie obviousness or by rebutting the prima facie case with evidence of secondary indicia of non-obviousness.

While this court reviews the Board determination in light of the entire record, an applicant may specifically challenge an obviousness rejection by showing that the Board reached an incorrect conclusion of obviousness or that the Board based its obviousness determination on incorrect factual predicates. The court reviews the ultimate determination of obviousness as a question of law. The Graham factual predicates underlying an obviousness determination include the scope and content of the prior art, the differences between the prior art and the claimed invention, and the level of ordinary skill in the art.

The secondary considerations are also essential components of the obviousness

determination. This objective evidence of non-obviousness includes long felt but unsolved need, failure of others, unexpected results created by the claimed invention and unexpected properties of the claimed invention, all of which are present in this case. In re Rouffet, supra.

With a factual foundation for its prima facie case of obviousness shown, the burden shifts to applicants to determine that their claim possesses an unexpected property over the prior art. An applicant may make this showing with evidence that the claimed invention exhibits some superior property or advantage that a person of ordinary skill in the relevant art would find surprising or unexpected. The basic principle behind this rule is straight forward, that which would have been surprising to a person of ordinary skill in a particular art would not have been obvious. In re Mayne, 104 F.3d 1339, 1343 (Fed. Cir. 1997).

If rebuttal evidence of adequate weight is produced, the holding of prima facie obviousness, being but a legal inference from previously uncontradicted evidence, is dissipated. Regardless of whether the prima facie case could have been characterized as strong or weak, the examiner must consider all of the evidence anew, which was not done in the present case.

When prima facie obviousness is established and evidence is submitted in rebuttal, the decision-maker must start over. An earlier decision should not, as it was here, be considered as set in concrete, and applicant's rebuttal evidence then be

evaluated only on its rebuttal value. Analytical fixation on an earlier decision can tend to provide that decision with an undeservedly broadened umbrella effect. Prima facie obviousness is a legal conclusion, not a fact. Facts established by rebuttal evidence must be evaluated along with the facts on which the earlier conclusion was reached, not against the conclusion itself. A final finding of obviousness may of course be reached, but such finding will rest upon evaluation of all facts in evidence, uninfluenced by any earlier conclusion.

Evidence of secondary considerations may often be the most probative and cogent evidence in the record. It may often establish that an invention appearing to have been obvious in light of the prior art was not. It is to be considered as part of all the evidence, not just when the decision-making remains in doubt after reviewing the art. In re Piasecki, 745 F.2d 1468, 1472, 1475 (Fed. Cir. 1984).

In the present case the Inventor set forth objective evidence which was ignored by the Examiner and the Board. In fact, the Examiner and Board stated that they would not consider such evidence since long range was not part of the claim, when in fact it was set forth in the specifications of the application and is the result of the invention. A13, 199, 200. Even if it were not in the claim, which it is, long range performance is significant objective evidence of nonobviousness and must be considered. Long range performance is only one of many energy saving facts of objective evidence which were completely ignored and refused to be considered by

the Examiner and Board. A13, 199, 200.

The construction of a patent claim is within the exclusive domain of this Court. The Court reviews claim interpretation de novo, including any allegedly fact-based questions relating to claim construction and interpretation. Markman v. Westview Instruments, Inc., 52 F.3d 967, 981 (Fed. Cir. 1995). In fact, this Court has specifically held that specifications of claims are to be reviewed in interpreting claims.

Claim construction is a matter of law reviewed de novo. . . . In interpreting claims, a court "should look first to the intrinsic evidence of record, i.e., the patent itself, including the claims, the specifications and, if in evidence, the prosecution history." Vitronics Corp. v. Conception, Inc., 90 F.3d 1576, 1582, (Fed. Cir. 1996). Sandt Tech., Ltd. v. Resco Metal and Plastics Corp., 264 F.3d 1344, 1353, (Fed. Cir. 2001).

"In patent law, a word . . . means nothing outside the claim and the description in the specification." Panduit v. Dennison Mfg. Co., 810 F.2d 1561, 1576 (Fed. Cir. 1987).

It is jurisprudentially inappropriate to disregard any relevant evidence on any issue in any case, patent cases included. Thus, evidence rising out of secondary considerations must always, when present, be considered en route to a determination of obviousness. It may often establish that an invention appearing to have been obvious in light of the prior art was not. It is to be considered as part of all the evidence, not just when the decisionmaker remains in doubt after reviewing the art. Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 1538-1539 (Fed. Cir. 1983).



It is error for the fact finder to fail to consider, or to at least discuss, objective evidence. Such evidence "may be sufficient to overcome a prima facie case of obviousness." Ruiz v. A. B. Chance Co., supra. In In re Beattie, supra, this court held that objective evidence must be given proper probative value. Hybritech, Inc. v. Monoclonal Antibodies, Inc., 802 F.2d 1367 (Fed. Cir. 1986), Cert. denied, 480 U.S. 947 (1987); Ashland Oil, Inc. v. Delta Resins, 776 F.2d 281 (Fed. Cir. 1985), Cert. denied, 475 U.S. 1017 (1986); In re Sernaker, 702 F.2d 989 (Fed. Cir. 1983).

The Inventor has presented the Board with secondary considerations in his Patent Application, A27, 47, 48, 67, and the brief before the Board, A231, 232, 233. However, both the Examiner and Board have refused to consider them. In fact, the Examiner and Board specifically refused to consider long range performance of the claimed vehicle based on claim interpretation. A13, 199, 200. Regardless of whether long range performance was in the actual claim, there is no doubt that long range performance produced new and unexpected results, and fulfilled a long felt and unresolved need where others have failed. Therefore, secondary consideration must be considered by the Board and failure to do so is reversible error.

The claimed vehicle has produced numerous secondary considerations that have been presented during the prosecution of this claim, which are set forth below, and others that are so obvious that this Court may take judicial notice of them. In re Sporck, 301 F.2d 686, 49 CCPA 1039 (CCPA 1962); In re Launder, 212 F.2d 603, 41

CCPA 887 (CCPA 1954).

The following revolutionary and innovative functions were not explored by the Board: As stated above, secondary considerations were raised by the Inventor on numerous occasions during the prosecution of this patent application. The terms long range performance and ultra light electric vehicle are used by the Inventor in the title and throughout the documents he has submitted. A19, 20, 22, 23, 25, 26, 27, 28, 29, 67, 151, 157. The Inventor states in his application that:

"The prior art two wheeled electric vehicles have very limited ranges, . . . " A30, 133, 187;

"The low drag, ultralightweight, highly energized, safer, non-polluting and long range two wheeled electric vehicle of the invention does not suffer from prior art problems and provides many positive advantages" A32;

"There is a great advantage in using an electric hybrid fueled by hydrogen, because the engine is approximately one third of the size required for combustion-only driven vehicles. That means, the electric-hybrid has approximately three times longer range per the same amount of hydrogen. Because compressed hydrogen storage is very bulky and heavy, prior art hydrogen powered vehicles have very limited range, similar to electric-only vehicles. The electric-hybrid vehicle configuration fueled by hydrogen makes the hydro-electric vehicle of the invention competitive with gasoline fueled, combustion-only vehicles, and is non-polluting. It should be noted that the negligible amounts of NO generated can be captured by catalytic converter 201." A47-48. See also A182, 185, 231;

"The electric-hybrid vehicle configuration fueled by hydrogen makes the hydrogen-electric vehicle of the invention competitive in the range with gasoline fueled combustion-only vehicles, and is non-polluting" A209-210, 224-225, 228, 230;

"The invention is a cost effective alternative to fuel cell vehicles, which is today's common proposal, and this alternative will not deplete the world's supply of platinum." A210.

The Inventor specifically used the term unexpected results several times during the prosecution of the application. A152, 226.

The Examiner and Board refused to consider as the Board stated, "numerous features of the disclosed invention (e.g., range of travel)" because they were not set forth in the claims themselves, A13, 242-243, and they had already made their decision of obviousness. Clearly, such reasoning is wrong. The Board has erred, it first must consider such factors as "range of travel", which is a secondary consideration, before it can determine obviousness. In effect, what the Board is saying is the invention is obvious because we have already decided its obvious, certainly, such reasoning is circuitous.

It is self evident that the present alternative fueled vehicle, hydrogen electric hybrid, would free the United States from oil imports, and therefore long range performance, makes it practical. Such a claim must be considered as objective evidence.

This Court has held ". . . that secondary considerations, when present, must be considered in determining obviousness" (emphasis added). Ruiz v. A. B. Chance Co., supra, 667. In this case, they were not considered.

At this point it is appropriate to quote from Graham, page 29 footnote 16:

By the same reasoning, may it not also be said that if [the device] solved a long-sought need, it was likewise novel? If it meets the requirements of being new, novel and useful, it was the subject of invention, although it may have been a short step, nevertheless it was the last step that ended the journey. The last step is the one that wins and he who takes it when others could not, is entitled to patent protection.

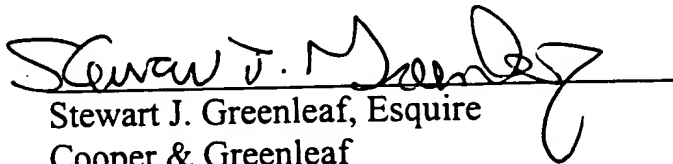
## CONCLUSION

For all of the foregoing reasons, Inventor respectfully requests that this Court reverse the Board denial of Inventor's Patent application. The Board has failed to establish factual findings to support a prima facie case. They failed to meet the Graham factual finding requirements and picked and chose elements of the prior art as a blueprint to establish obviousness where the Inventor's claims as a whole were not suggested. Finally, the Board completely ignored and refused the secondary considerations, even though when present they must be considered.

Where the secondary considerations are present, unchallenged and ignored by the fact finder, then this Court may as a matter of law consider such objective evidence in reviewing the ultimate conclusion of obviousness or nonobviousness and reverse. Where the evidence is controverted the matter normally will be remanded for the consideration of the evidence. Ashland Oil Inc. v. Delta Resins, supra. The Inventor requests that the decision be reversed and the Board be ordered to issue the subject patent.

Respectfully submitted,

Dated: July 28, 2003

  
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# **ADDENDUM**

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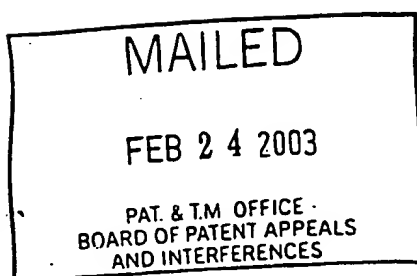
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The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

Paper No. 30

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES



Ex parte JOSEPH B. KEJHA

Appeal No. 2002-1780  
Application No. 08/950,445

HEARD: February 4, 2003

Before ABRAMS, FRANKFORT, and NASE, Administrative Patent Judges.  
NASE, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 10 to 12. Claims 1 to 9 and 13 to 33, which are all of the other claims pending in this application, have been withdrawn from consideration.

We AFFIRM.

BACKGROUND

The appellant's invention relates to an electric vehicle. A copy of the claims under appeal is set forth in the opinion section below.

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

West	3,517,766	June 30, 1970
Munday	5,143,025	Sept. 1, 1992
Minami et al. (Minami)	5,462,021	Oct. 31, 1995

Claim 10 stands rejected under 35 U.S.C. § 103 as being unpatentable over West in view of Minami.

Claims 10 to 12 stand rejected under 35 U.S.C. § 103 as being unpatentable over West in view of Munday.

Rather than reiterate the conflicting viewpoints advanced by the examiner and the appellant regarding the above-noted rejections, we make reference to the answer (Paper No. 25, mailed February 21, 2002) for the examiner's complete reasoning in support of the rejections, and to the brief (Paper No. 24, filed December 10, 2001) for the appellant's arguments thereagainst.



OPINION

In reaching our decision in this appeal, we have given careful consideration to the appellant's specification and claims, to the applied prior art references, and to the respective positions articulated by the appellant and the examiner. As a consequence of our review, we make the determinations which follow.

The test for obviousness is what the combined teachings of the references would have suggested to one of ordinary skill in the art. See In re Young, 927 F.2d 588, 591, 18 USPQ2d 1089, 1091 (Fed. Cir. 1991) and In re Keller, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981). Moreover, in evaluating such references it is proper to take into account not only the specific teachings of the references but also the inferences which one skilled in the art would reasonably be expected to draw therefrom. In re Preda, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968).

When it is necessary to select elements of various teachings in order to form the claimed invention, we ascertain whether there is any suggestion or motivation in the prior art to make the selection made by the appellant. Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination. The extent to which such suggestion must be explicit in, or may be fairly inferred from,

the references, is decided on the facts of each case, in light of the prior art and its relationship to the appellants' invention. As in all determinations under 35 U.S.C. § 103, the decision maker must bring judgment to bear. It is impermissible, however, simply to engage in a hindsight reconstruction of the claimed invention, using the appellant's structure as a template and selecting elements from references to fill the gaps. The references themselves must provide some teaching whereby the appellant's combination would have been obvious. In re Gorman; 933 F.2d 982, 986, 18 USPQ2d 1885, 1888 (Fed. Cir. 1991) (citations omitted). That is, something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. See In re Beattie, 974 F.2d 1309, 1312, 24 USPQ2d 1040, 1042 (Fed. Cir. 1992); Lindemann Maschinenfabrik GmbH v. American Hoist and Derrick Co., 730 F.2d 1452, 1462, 221 USPQ 481, 488 (Fed. Cir. 1984).

#### **The claimed subject matter under appeal**

Claims 10 to 12 read as follows:

10. Electric vehicle construction which includes a body for carrying at least one passenger and an electric propulsion system with at least one electric motor, at least one battery, at least one electric current generator for charging said battery and which is driven by an internal combustion engine, and a hydrogen storage system having hydrogen therein attached to said body, and which body rides on two wheels with a steering system attached to said body, the improvement wherein

said engine is an open to air combustion engine and is fueled only by said hydrogen.

11. Electric vehicle construction which includes a body for carrying at least one passenger and an electric propulsion system with at least one motor, at least one battery, at least one electric current generator for charging said battery and which is driven by an internal combustion engine, and a hydrogen generating cell attached to said body, and which body rides on two wheels with a steering system attached to said body, the improvement wherein

said engine is open to air combustion engine and is fueled only by hydrogen which is produced by electrolysis of water in said hydrogen generating cell, said cell is electrically connected to said generator and also to said battery, the hydrogen is not stored under pressure and is immediately consumed by said engine.

12. Electric vehicle construction which includes a body for carrying at least one passenger and electric propulsion system with at least one electric motor, at least one battery, at least one electric current generator for charging said battery and which is driven by an internal combustion engine, a hydrogen storage system having hydrogen therein and a hydrogen generating cell which generates hydrogen by electrolysis of water, the improvement wherein

said engine is open to air combustion engine and is fueled only by hydrogen, the hydrogen being supplied from said storage system and from said hydrogen generating cell, said cell is electrically connected to said generator, and said cell is also electrically connected to said battery.

### **The teachings of the applied prior art**

#### **West**

West's invention relates to improvements in battery-operated vehicles and, more particularly, to an electric power supply system for a battery-operated vehicle, the electric battery of which is able to be continuously charged through a generator driven by a small internal combustion engine. One object of West's invention was to provide a vehicle for transportation on streets, roads, parkways, super-highways and the like, particularly in towns or congested areas where air pollution is a troublesome problem.

Figure 1 of West shows a vehicle with a light body 1 carried by front and rear wheels 2f and 2r of a wheeled chassis. Road wheels 2f are connected through a differential gear 3 and are driven by an electric traction motor 4 through a gear box 5. The front wheels 2f are connected to a steering column 6 through a suitable mechanical joint 7 as those skilled in the art will readily understand. A single pedal control 8 is shown mechanically connected to a potentiometer 9. A battery 10 is connected to the potentiometer 9 through conduits 11 and 12 and the electric traction motor 4 is connected through conduit 13. At the rear of the vehicle is an internal combustion engine 14 connected mechanically through a gear box 15 to drive twin generators 16 and 17. Conduits 18 and 19 from the twin generators 16 and 17 connect the generators to the battery 10 and also to the electric circuit of the traction motor 4 and the potentiometer 9. West refers to the internal combustion engine 14 as a petrol (i.e., gasoline) engine at various places in the specification (e.g., column 5, line 20; column 8, line 15; column 9, line 13).

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Application No. 08/950,445

*Minami*

Minami's invention relates to a hydrogen gas supply system for a hydrogen engine<sup>1</sup> which is a clean engine which emits only water. The hydrogen gas supply system of Minami's invention can be mounted on a vehicle in the following manner. For example, as shown in Figures 15 and 16, in the case of a cab-over type vehicle in which a cabin 102 is positioned above a hydrogen engine 101, a connection unit 107 is provided between a pair of side frames 104 and 105 near the rear end of a vehicle body 103 and another connection unit 108 is provided on the outer side of the side frame 104 with connection units being exposed downward. Reference numeral 106 denotes hydrogen fuel cartridges. The connection unit 108 is mounted to be swung outward as shown by the chained line in Figure 16 and the fuel cartridges 106 are changed with the connection unit 108 in the swung position. In the case of a sedan type vehicle 109, a connection unit 113 is provided between side frames 111 and 112 below a trunk 110 on the rear of the vehicle to extend in the transverse direction of the vehicle body as shown in Figures 17 and 18.

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<sup>1</sup> The examiner has characterized the hydrogen engine of Minami as an internal combustion engine (answer, p. 4). However, Minami does not describe his hydrogen engine as an internal combustion engine and we fail to find any evidence that Minami's hydrogen engine is an internal combustion engine which is an open to air combustion engine as recited in each of the claims under appeal.

*Munday*

Munday's invention relates generally to a fuel system of internal combustion engines, and more particularly to a hydrogen and oxygen producing system to provide fuel to an internal combustion engine.

Munday teaches in the background of the invention section (column 1, lines 10-39) that

[p]etroleum fuels have been used to operate internal combustion engines ever since the invention of the internal combustion engine. In fact, petroleum fuels have been used so much over the past one hundred years they are becoming short in supply. Shortage of gasoline has at times created gasoline lines at filling stations. Because of pending greater shortages, there are several research projects focused on new sources of fuels. Petroleum shale has been researched as a potential new source of fuels, however, research has been expensive and slow. Another source of fuel is natural gas.

A greater problem with the use of petroleum fuels is the pollution created by burning them. Petroleum products contain several pollutants such as sulfur compounds, carbon monoxide, and trace metals that are released into the atmosphere when burned. The obvious concerns with petroleum pollutants are the effects on the environment and humans. Wildlife and plant life are being destroyed by the effects of pollution. Humans are developing respiratory problems and other pollution related problems.

There have been attempts to provide an internal combustion engine that would use fuels other than petroleum fuels. One of the better known fuels is alcohol, which was used during the Second World War in European countries. Another is hydrogen gas which has a low flash point and very dangerous to carry in a vehicle. Finally, mixtures of hydrogen and oxygen gases have been used as fuel for internal combustion engines.

The primary object of Munday's invention was to provide a hydrogen and oxygen gases production system by electrolysis of water for direct use in an internal combustion engine. Another object of the invention was to provide a hydrogen and oxygen gases production system adaptable to existing internal combustion engines.

Figure 1 shows an internal combustion engine 10 connected by an intake manifold 12 and an exhaust manifold 14 to a fuel tank 16. An oxygen gas inlet manifold 18 carries oxygen gas to the inlet manifold 12. Hydrogen gas inlet manifold 20 also carries gas to the inlet manifold 12. The two gases, hydrogen and oxygen, are mixed together just before entering the inlet manifold to prevent any flash back. Exhaust gases are moved from the engine 10 through manifold 14 and exhaust tube 22 which empties into the fuel tank 16.

As better shown in Figure 2, oxygen is removed from the fuel tank 16 and carried to a vertical mixing or combining manifold 24. Hydrogen is similarly removed from the fuel tank 16 and carried to the mixing manifold 24 which has an opening 25 to the intake manifold 12 and separate inlet pipes 18 and 20 where the two gases are combined before entering the manifold 12. A single cylinder 26 and a reciprocating piston 28 represent the internal combustion engine. The fuel gases are forced into the cylinder 26 and pass an intake valve 30 which opens and closes to only emit gases. An

valve 32 opens to allow egress of used gases and water vapor. The fuel gases are ignited by a spark from spark plug or glow plug 34.

The fuel production tank 16 (see Figures 2 and 5-7) is divided into three compartments 36, 38 and 40 by dividers 42 and 44. There is communication between the compartments along the bottom of the tank 16. Water is allowed to flow between the compartments along the bottom of the tank. On the other hand, the dividers 42 and 44 have inclined top walls 46 and 48, respectively, which isolates the hydrogen gases in compartment 36 from the oxygen gases in compartment 40. Each compartment 36 and 40 has an outlet 50 and 52, respectively, for removing the electrolytically produced hydrogen and oxygen. Center compartment 38 is for receiving additional water for the tank and for the exhausted gases and water vapor from exhaust pipe 22. Center compartment 38 has an inlet 54 for admitting exhaust gases and water vapor.

A plurality of cathodes 56 are mounted in compartment 36 with the electrode positioned above the bottom edge of partition 42 to prevent hydrogen formed by the cathodes 56 from escaping. Each cathode 56 has an electrical lead 58 which connects to a source of electricity. A glass or some type of insulating tube 60 surrounded the cathodes 56 to keep the hydrogen gases away from the cathodes, making them more



Appéal No. 2002-1780  
Application No. 08/950,445

efficient. A similar number of anodes 62 are mounted in compartment 40, again with the electrodes positioned above the bottom edge of partition 44 to prevent oxygen formed by the anodes 62 from escaping. Each anode 62 has an electrical lead 64 which connects to a source of electricity. Glass or some type of insulating tube 60 surrounds the anodes 62 to keep the oxygen gases away from the anodes.

Figure 3 is a schematic of the internal combustion engine 10 and the fuel production tank 16. The production tank 16 is divided into hydrogen and oxygen production compartments 36 and 40, respectively. There is a divider 57 separating the compartments 36 and 40. In this figure there is no center compartment 38 as in Figure. 2, instead exhaust gases are pumped into compartment 36. Fresh water is added via fill pipe 66 into compartment 40. There are cathodes 56 in compartment 36, and anodes 62 in compartment 40.

**The rejection of claim 10 over West in view of Minami**

We will not sustain the rejection of claim 10 under 35 U.S.C. § 103 as being unpatentable over West in view of Minami.

In our view, the subject matter of claim 10 is not suggested by the combined teachings of West and Minami. While the combined teachings of West and Minami may

have suggested modifying West's electric vehicle by replacing West's internal combustion engine 14 with a hydrogen engine supplied with fuel from a hydrogen gas supply system as taught by Minami, we have not found any evidence that Minami's hydrogen engine is an internal combustion engine which is an open to air combustion engine as recited in claim 10. Since the applied prior art does not establish that Minami's hydrogen engine is an internal combustion engine which is an open to air combustion engine, we conclude that the applied prior art fails to establish that it would have been obvious at the time the invention was made to a person of ordinary skill in the art to have modified West's electric vehicle to arrive at the subject matter of claim 10.

For the reasons set forth above, the decision of the examiner to reject claim 10 under 35 U.S.C. § 103 as being unpatentable over West in view of Minami is reversed

**The rejection of claims 10 to 12 over West in view of Munday**

We sustain the rejection of claims 10 to 12 under 35 U.S.C. § 103 as being unpatentable over West in view of Munday.

In our view, the subject matter of claims 10 to 12 is suggested by the combined teachings of West and Munday. In applying the above-noted test for obviousness, we reach the conclusion that it would have been obvious at the time the invention was

Appeal No. 2002-1780  
Application No. 08/950,445

made to a person of ordinary skill in the art to have modified West's electric vehicle by modifying West's internal combustion engine 14 to be fueled by hydrogen as suggested and taught by Munday to reduce pollution as taught by Munday.

The arguments advanced by the appellant (brief, pp. 23-27) do not convince us that the currently claimed subject matter is patentable under 35 U.S.C. § 103 over the combined teachings of West and Munday. As should be apparent from the preceding paragraph we disagree with the appellant that the claimed subject matter is not suggested by the applied prior art. While the appellant is correct that both West and Munday lack certain features of the claimed invention, it is well-established that nonobviousness cannot be established by attacking the references individually when the rejection is predicated upon a combination of prior art disclosures. See In re Merck & Co. Inc., 800 F.2d 1091, 1097, 231 USPQ 375, 380 (Fed. Cir. 1986). In addition, the appellant points out numerous features of the disclosed invention (e.g., range of travel), however, features not claimed cannot be relied on to establish patentability. See In re Self, 671 F.2d 1344, 1348, 213 USPQ 1, 7 (CCPA 1982). Lastly, with regard to claim 12, we agree with and incorporate the examiner's rationale set forth in the answer (p. 8) that the claimed hydrogen storage system and hydrogen generating cell are met by Munday's system. In that regard, we note that the claim 12 does not recite both a valved hydrogen tank and a hydrogen generating cell supplying hydrogen to an internal

combustion engine which is an open to air combustion engine and is fueled only by hydrogen.

For the reasons set forth above, the decision of the examiner to reject claims 10 to 12 under 35 U.S.C. § 103 as being unpatentable over West in view of Munday is affirmed.

#### CONCLUSION


To summarize, the decision of the examiner to reject claim 10 under 35 U.S.C. § 103 as being unpatentable over West in view of Minami is reversed and the decision of the examiner to reject claims 10 to 12 under 35 U.S.C. § 103 as being unpatentable over West in view of Munday is affirmed.

Since at least one rejection of each of the appealed claims has been affirmed, the decision of the examiner is affirmed.

Appeal No. 2002-1780  
Application No. 08/950,445

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

**AFFIRMED**

  
NEAL E. ABRAMS  
Administrative Patent Judge

*Charles E. Frankfort*  
CHARLES E. FRANKFORT  
Administrative Patent Judge

  
JEFFREY V. NASE  
Administrative Patent Judge

BOARD OF PATENT  
APPEALS  
AND  
INTERFERENCES

Appeal No. 2002-1780  
Application No. 08/950,445

Page 16

OSEPH B. KEJHA  
1022 FREDERICK RD  
MEADOWBROOK, PA 19046

JVN/jg

**Add.- 16**

## PATENT APPLICATION TRANSMITTAL LETTER

Docket Number (Optional)

JBK-6

To the Commissioner of Patents and Trademarks:

Transmitted herewith for filing is the patent application of

JOSEPH B. KEJHA

entitled LONG RANGE AND ULTRALIGHT ELECTRIC VEHICLE

Enclosed are:

- ☒ 8 sheets of drawings.
- ☐ an assignment of the invention to \_\_\_\_\_
- ☒ executed declaration of the inventors.
- ☐ a certified copy of a \_\_\_\_\_ application.
- ☐ associate power of attorney.
- ☒ a verified statement to establish small entity status under 37 CFR 1.9 and 1.27.
- ☒ information disclosure statement
- ☐ preliminary amendment
- ☒ other: Cross Reference to related Disclosures

## CLAIMS AS FILED

	NUMBER FILED	NUMBER EXTRA	RATE	FEE
BASIC FEE			\$630.770	\$630.770
TOTAL CLAIMS	34 - 20 =	14	x \$20.22	\$308
INDEPENDENT CLAIMS	8 - 3 =	5	x \$60.80	\$400
MULTIPLE DEPENDENT CLAIM PRESENT			\$200.260	\$260
* NUMBER EXTRA MUST BE ZERO OR LARGER			TOTAL	\$ 1,738
If applicant has small entity status under 37 CFR 1.9 and 1.27, then divide total fee by 2, and enter amount here.			SMALL ENTITY TOTAL	\$ 869

- ☒ A check in the amount of \$ 869.00 to cover the filing fee is enclosed.
- ☐ The Commissioner is hereby authorized to charge and credit Deposit Account No. \_\_\_\_\_ as described below. I have enclosed a duplicate copy of this sheet.
- ☐ Charge the amount of \$ \_\_\_\_\_ as filing fee.
- ☐ Credit any overpayment.
- ☐ Charge any additional filing fees required under 37 CFR 1.16 and 1.17.
- ☐ Charge the issue fee set in 37 CFR 1.18 at the mailing of the Notice of Allowance, pursuant to 37 CFR 1.311(b).

10-14-1997

Date

Joseph B. Kejha  
Signature

Page Blank (uspto)



# MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

(For use with Form PTO/SB/06)

Application Number

UNKNOWN

Filing Date

CONCURRENTLY

Applicant(s)

JOSEPH B. KEJHA

May be used for additional claims or amendments

CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT	
	Indep	Depend	Indep	Depend	Indep	Depend
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10	IND					
11	IND					
12	IND					
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14		1				
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27	IND					
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Total Indep	8					
Total Depend	26					
Total Claims	34					

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Total Claims						

## DECLARATION FOR PATENT APPLICATION

Docket Number (Optional)

JBK-6

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled LONG RANGE AND ULTRALIGHT ELECTRIC VEHICLE, the specification of which

is attached hereto unless the following box is checked:

☐ was filed on \_\_\_\_\_ as United States Application Number or PCT International Application Number \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Claimed

(Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed
_____	_____	_____	<input type="checkbox"/> Yes <input type="checkbox"/> No
_____	_____	_____	<input type="checkbox"/> Yes <input type="checkbox"/> No
_____	_____	_____	<input type="checkbox"/> Yes <input type="checkbox"/> No

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Number)	(Filing Date)	(Status - patented, pending, abandoned)
_____	_____	_____

(Application Number)	(Filing Date)	(Status - patented, pending, abandoned)
_____	_____	_____

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Address all telephone calls to JOSEPH B. KEJHA at telephone number (215) 947-8019  
 Address all correspondence to JOSEPH B. KEJHA  
1022 FREDERICK RD., MEADOWBROOK, PA. 19046 U.S.A.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor (given name, family name) JOSEPH B. KEJHA  
 Inventor's signature Joseph B. Kejha Date 10-14-1997  
 Residence 1022 FREDERICK RD. MEADOWBROOK, PA. 19046 Citizenship U.S.  
 Post Office Address \_\_\_\_\_

Full name of second joint inventor, if any (given name, family name) \_\_\_\_\_  
 Second Inventor's signature \_\_\_\_\_ Date \_\_\_\_\_  
 Residence \_\_\_\_\_ Citizenship \_\_\_\_\_  
 Post Office Address \_\_\_\_\_

☐ Additional inventors are being named on a separate sheet attached hereto.

VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS  
(37 CFR 1.9(f) & 1.27(b))--INDEPENDENT INVENTOR

Docket Number (Optional)

JBK-6

Applicant or Patentee: JOSEPH B. KEJHA

Serial or Patent No.: UNKNOWN

Filed or Issued: CONCURRENTLY

Title: LONG RANGE AND ULTRALIGHT ELECTRIC VEHICLE

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- ☒ the specification filed herewith with title as listed above.  
☐ the application identified above.  
☐ the patent identified above.

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☐ No such person, concern, or organization exists.  
☒ Each such person, concern or organization is listed below.

ELECTRION INC.  
1022 FREDERICK Rd.  
MEADOWBROOK, PA. 19046

Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

JOSEPH B. KEJHA  
NAME OF INVENTOR

Signature of inventor

Joseph B. Kejha  
Date 10-14-1997

NAME OF INVENTOR

Signature of inventor

Date

NAME OF INVENTOR

Signature of inventor

Date

Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN THE APPLICATION OF: Joseph B. Kejha  
U.S. SERIAL NO: Unknown  
FILED: Concurrently  
FOR: Long Range and Ultralight Electric Vehicle  
GROUP: Unknown  
EXAMINER: Unknown

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Meadowbrook, Pennsylvania  
October 14, 1997

INFORMATION DISCLOSURE STATEMENT

Commissioner of Patents & Trademarks  
Washington, D.C. 20231

Dear Sir:

The applicant submits copies of the following references:

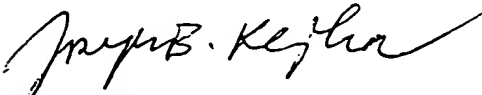
U.S. Patent No. 4,031,865 discloses a conventional fuel combustion engine in combination with a hydrogen generating cell, which improves the range of the vehicle.

U.S. Patent No. 4,112,875 discloses a closed cycle combustion engine fueled by compressed hydrogen and oxygen and having a noble gas as working fluid. Said engine works in combination with solar cells.

Sun Cat Motor Co. advertisement brochure 1996 discloses an electric scooter having lead batteries and range 25 miles.

ZAP Power Systems Co. advertisement brochure 1995 discloses an electric bicycle having lead battery and electric motor with friction drive of the rear wheel. The bicycle has 20 miles range with pedaling.

Respectfully submitted,

  
Joseph B. Kejha  
(applicant)

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN THE APPLICATION OF: Joseph B. Kejha  
U.S. SERIAL NO: Unknown  
FILED: Concurrently  
FOR: Long Range and Ultralight Electric Vehicle  
GROUP: Unknown  
EXAMINER: Unknown

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Meadowbrook, Pennsylvania  
October 14, 1997

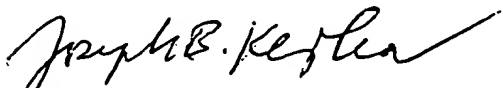
CROSS REFERENCE TO RELATED DISCLOSURES

Commissioner of Patents & Trademarks  
Washington, D.C. 20231

Dear Sir:

The applicant wishes to bring to your attention that this application is a continuation in part of a prior co-pending disclosure document of Joseph B. Kejha No. 383,278 filed October 16, 1995, entitled "Long Range and Ultralight Electric Vehicle", and No. 405,199 filed September 6, 1996, entitled "Circuitry for Individual Batteries Protection from Overcharge and Overdischarge" and said disclosure documents should be preserved permanently.

Respectfully submitted,

  
Joseph B. Kejha  
(applicant)

PATENT

TITLE

Long Range and Ultralight Electric Vehicle

INVENTOR

Joseph B. Kejha

1022 Frederick Road

Meadowbrook, PA 19046 U.S.A.

Citizenship: U.S.

LONG RANGE AND ULTRALIGHT ELECTRIC VEHICLE

Cross Reference to Related Documents

This application is related to a prior co-pending Disclosure Document of Joseph B. Kejha, Serial No. 383,278 filed October 16, 1995, entitled "Long Range and Ultralight Electric Vehicle." This application is also related to a prior co-pending Disclosure Document of Joseph B. Kejha, Serial No. 405,199 filed September 6, 1996, entitled "Circuitry for Individual Batteries Protection from Overcharge and Overdischarge." This application is also a continuation in part of the prior co-pending patent application of Joseph B. Kejha, Serial No. 08/373,090 filed January 17, 1995, entitled "Long Range and Safer Electric Vehicle Construction," which is related to a prior co-pending Disclosure Document of Joseph B. Kejha, Serial No. 322,973 filed January 12, 1993, entitled "Long Range and Safer Electric Vehicle Construction."



## Background of the Invention

### Field of the Invention

This invention pertains mostly to two wheeled and steered, long range and ultralight electric vehicle for at least one passenger, which is seated in a recumbent position, with substantially reduced frontal area, and having aerodynamically shaped front shield and body. The vehicle body is constructed from lightweight, impact resistant and energy absorbing materials. The vehicle has highly advanced non-polluting and economical propulsion and back-up power system.

### Description of the Prior Art

Prior art two wheeled and steered electric vehicles are of similar construction as internal combustion engine driven motorcycles or scooters; that is to say that driver was seated on a narrow uncomfortable seat in high upright position, or leaning forward (head first) position, which causes high air drag, wrist fatigue and it is dangerous in an accident. The only difference is that the combustion engine with gas tank was replaced by an electric motor with batteries. Prior art electric scooters or motorcycles have body frame made from steel or aluminum of various sections, welded together, and with fiberglass, plastic, or sheet metal panels attached to the frame. Vehicle construction which uses steel or glass fibers produces a body which is relatively heavy for use in an advanced electric vehicle. While aluminum metal is lightweight, it is not the most lightweight structural metal. Other fibers, such as carbon fibers, are brittle and dangerous in a crash, as they have low impact resistance, and aramid fibers are tough, but not the most lightweight fibers.

The prior art electric motorcycles or scooters often have high pressure air filled tires, which can blow out and cause accidents.

Prior art two wheeled electric vehicles have very limited ranges, not only because of their limited available space for batteries, their body weight and high drag, but also because they utilize low specific energy density batteries.

Prior art two wheeled electric vehicles have also no protection of batteries from overcharge or overdischarge when connected in series for high voltage, which shortens the batteries life.

For electric vehicles, other than two-wheeled, an electric-hybrid construction has been proposed to increase the range, but the non-electric portion is not free from atmospheric pollution.

An engine which only reduces the atmospheric pollution and extends the range is proposed in U.S. patent of Dufour No. 4,031,865, which discloses a hydrogen generating cell used only as a supplement to a conventional gas fuel, such as gasoline, to improve the efficiency of the engine. Dufour fails to teach non-polluting, hydrogen generating system which is consuming only water, or only water and hydrogen.

U.S. patent No. 4,112,875 of Laumann et al. discloses a hydrogen-oxygen fueled, closed cycle internal combustion engine system in combination with solar cells, and which uses a pressurized noble gas, such as argon, as a working fluid, and which stores hydrogen and oxygen gases in storage devices under pressure, which is very dangerous, heavy and space demanding. Such system would be too heavy, bulky and difficult to seal for use in a two wheeled vehicle.

The low drag, ultralightweight, highly energized, safer, non-polluting and long range two wheeled electric vehicle of the invention does not suffer from prior art problems and provides many positive advantages.

### Summary of the Invention

It has now been found that long range, safer, non-polluting and ultralight electric vehicles for at least one passenger, and which is riding on two wheels can be made as follows, by:

1. Seating the rider (passenger) in a recumbent or reclining position (feet first), on a wide and comfortable seat with back support and attaching the seat to a low, longitudinal, approximately horizontal frame beam, in adjustable manner, so that the rider's feet can reach the ground on both sides of said frame beam. This configuration increases the safety in case of an accident, due to rider's closer distance to the ground and "feet first" position. It also substantially decreases the air drag of the vehicle and improves maneuvering, due to low center of gravity. In addition, the wide seat protects rider's hips and shoulders. During the ride, the rider's feet rest on a relatively small, fixed, but horizontally adjustable platform in front of the vehicle and above and forward of a smaller front wheel, and the feet are easily removable to reach the ground.

2. Providing an aerodynamic front shield, covering only the feet rest platform, feet, front steering and other selected components of the vehicle to further reduce air drag, but not to fully enclose the rider or to prevent his feet from easily reaching the ground.

3. Providing steering handle bars within easy reach and

in front of the reclining driver, with a vertical torsional tube connected to the front wheel fork; or an aircraft type steering handles ("horns" or "semiwheel") with an approximately horizontal torsional tube, connected with universal joints to an approximately vertical torsional rod or tube with a lever and push-pull rods of the front wheel lever and fork.

4. Providing two rear view mirrors which are wider than vehicle body, but are mounted to, and aerodynamically streamlined with the front shield, and are thus protecting the rider's hands.

5. Mounting an electric motor and preferably disc armature motor in low position behind the rider's seat, with preferably timing belt reduction drive to a preferably larger rear wheel, and positioning said rear wheel behind the seat.

6. Mounting batteries under the seat and protecting them from overcharge and overdischarge by charging them only individually in parallel to predetermined limits and discharging them together in series, but with individual disconnect, when discharged to predetermined limits.

7. Mounting a small internal combustion engine, with preferably multiple generator for charging the batteries and cruising, on a shelf above the rear wheel and behind the seat, or on the side of the rear wheel, and covering it with an aerodynamic cone cover.

8. Fueling said engine with non-polluting hydrogen gas, produced on demand only for safety, by electrolysis of water

carried in the vehicle, or stored in a metal hydride tank, or both.

9. Lowering the total weight of the vehicle and further increasing the safety by using magnesium metal, and preferably magnesium alloy extrusions adhesively joined by various fittings, for vehicle body frame construction, and which frame supports and holds together all above described components, and by using ultrahigh molecular weight polyethylene fibers with a resin or just polyethylene sheets for the front shield and the rear cone cover construction, and by using lightweight pressure-airless tires.

10. Mounting electrical control box preferably behind the seat.

In addition, it has been also found that some or all of the vehicle batteries can be replaced or supplemented by capacitors and/or a fuel cell system and preferably by a water based fuel cell system.

The principal object of the invention is to provide a safer, steerable electric vehicle which can carry at least one passenger, which has two wheels, and has a low aerodynamic drag, is lightweight, has a low energy consumption and long range, while being non-polluting.

A further object of the invention is to provide two wheeled electric vehicle which has a longer operating range than prior art two wheeled electric vehicles, due to its highly advanced propulsion systems.

A further object of the invention is to provide two

wheeled electric vehicle which is easy and economical to manufacture.

A further object of the invention is to provide two wheeled electric vehicle which has improved vehicle maneuvering and steering.

A further object of the invention is to provide two wheeled electric vehicle which has long operating life.

A further object of the invention is to provide two wheeled electric vehicle which is environmentally friendly and is constructed of recyclable materials.

Other objects and advantageous features of the invention will be apparent from the description and claims.



Brief Description of the Drawings

The nature and characteristic features of the invention will be more readily understood from the following descriptions taken in connection with the accompanying drawing forming part hereof in which:

Figure 1 is a side elevational and partly sectional view of the electric vehicle of the invention, illustrating various components of the vehicle, their locations, and positioning of the driver, which is holding an aircraft-type steering handlebars, according to the subject invention;

Figure 2 is a top elevational and partly sectional view of the electric vehicle of the invention, according to the subject invention;

Figure 3 is a front plan view of the vehicle of the invention, illustrating front aerodynamic shield with lights and protruding, streamlined rear view mirrors, according to the subject invention;

Figure 4 is a side elevational view of another embodiment of the electric vehicle of the invention, illustrating simplified front wheel steering, and a lower motor/generator unit mounting, as well as retractable side legs, according to the

subject invention;

Figure 5 is a side elevational view of another embodiment of the electric vehicle of the invention, illustrating extended frame and configuration of two passengers, according to the subject invention;

Figure 6 is a simplified schematic diagram illustrating the principle of the hydrogen fueled propulsion system, according to the subject invention;

Figure 7 is a simplified wiring schematic diagram illustrating the principle of protecting the individual batteries of the electric vehicle of the invention from overcharge and overdischarge;

Figure 8 is a side elevational view of another alterned electric vehicle of the invention, showing recumbent electric hybrid moped with front pedal drive, according to the subject invention;

Figure 9 is an axionometric view of aircraft type handelbars and steering system of the electric vehicle of the invention;

Figure 10 is an axionometric view of body frame and seat of the vehicle of the invention, showing plurality of extrusions joined by adhesive and various fittings;

Figure 11 is an axionometric view of welded body frame of the vehicle of the invention;

Figure 12 is a side sectional view of front aerodynamic shield of the vehicle of the invention, showing composite sandwich construction with honeycomb core;

Figure 13 is a side sectional view of front aerodynamic shield of the vehicle of the invention, showing double-walled plastic construction;

Figure 14 is a side sectional view of electric motor of the vehicle of the invention, taken approximately on line 14-14 of Figure 15, and illustrating disc armature and magnets;

Figure 15 is a front view of electric motor of the vehicle of the invention.

Like numerals refer to like parts throughout the several views and figures.

It should, of course, be understood that the description and the drawings herein are merely illustrative, and it will be apparent that various modifications, combinations and changes can be made of the structures and the systems disclosed without departing from the spirit of the invention and from the scope of the appended claims.

### Description of the Preferred Embodiments

When referring to the preferred embodiments certain terminology will be utilized for the sake of clarity. Use of such terminology is intended to encompass not only the described embodiment, but also all technical equivalents which operate and function in substantially the same way to bring about the same results.

The light electric vehicle and for example one passenger electric vehicle comprises, a body which is usually riding on two wheels with a steering and braking system, a seat, an electric motor with a controller and a reduction drive connected to the rear wheel through a chain, a battery pack to store the electric energy, an instrumentation package and various lights.

The optional equipment may consist of an electric charger, a cooling system of the electric motor and batteries, various electronic packages and an auxiliary internal combustion engine system with a generator.

The body may consist of a frame with the body panels attached to it. All above components may also be attached to said frame.

The preferred two wheeled electric vehicle construction of the invention was generally described in my prior disclosure documents Serial No. 383,278 and Serial No. 405,199 and in part Serial No. 322,973.

Referring now in more detail, particularly to the drawings of this patent and Figures 1, 2, and 3, one embodiment of the electric vehicle of the invention 1 has a body frame 2 with front, steered wheel 3 and rear, driven wheel 4. The driver 5 sits in a recumbent, wide seat 6 with back support 7, in a reclining position, similar to an automobile driver's position, and is lower to the ground level than a conventional motorcyclist, and the seat 6 is of such height, that the driver's feet can easily reach the ground on both sides of the frame 2. The seat 6 and support 7 protect driver's hips and shoulders. During the ride, the driver's legs are above the front wheel 3 and his feet rest on a small fixed platform 8, above and in front of the front wheel, and said platform is horizontally lengthwise adjustable telescopically to fit different drivers. The described seating arrangement lowers the center of gravity of the vehicle, makes the vehicle lower and safer, and more maneuverable, and makes also possible a very simple and lightweight, approximately horizontal beam 2A with a rear wheel fork 9, mast 10, braces 11 and 11A attached to it, to form the body frame 2. The seat 6, front wheel fork 12, platform 8, and steering system 13 are also attached to said body frame. The steering handles 14 should be within easy reach of the driver 5, and may be part of an aircraft type "horns" or "semi-wheel" handlebars, which gives an automobile steering feeling to the driver. Handlebars of this type are attached to approximately horizontal or slightly inclined torsional element, such as rod

or tube 15, which is connected to an approximately vertical or slightly tilted torsional element 16, through at least one bellow or universal joint 17 and element 18. All this steering mechanism is supported by bearings or bushings embedded in preferably trapezoidal or triangular support structure 19. The vertical tube 16 may go through the horizontal frame 2, in front of the front wheel 3 and fork 12, and has attached a lever 20 at the bottom and preferably under the frame 2. One, or two push-pull rods 21 are attached preferably through ball joint pins to the lever 20 and connects it to a second lever 22 which is attached to the fork 12 of the wheel 3, also by pins. By rotating the handlebars similarly as a steering wheel in an automobile, the steering motion is transferred through the described torsional elements and universal joints to the bottom lever and then through the push-pull rods to the second lever 22 of the front wheel fork 12, which fork is anchored in a bearing housing 23, which is attached to the frame 2. The front wheel fork 12 with the wheel 3 can rotate around it's approximately vertical axis and this motion is controlled from handlebars by above described mechanism. Motion of the lever 20 and thus the wheel 3 may be limited as desired by a preferably adjustable stop block 24 in front of the tube 16 and lever 20. This steering system is also shown separately in Figure 9, which is another embodiment of the invention. The feet of the driver, as well as the feet rest platform 8, the steering mechanism and other selected components may be covered

by front, streamlined aerodynamic shield 25, which may be also referred to as a "bubble" or "nose"; and possibly with a transparent windshield, or the shield itself may be transparent. The shield further reduces the air drag and should be attached to the horizontally adjustable feet rest platform 8. The shield may also cover or contain an electric motor controller 27, fuel tank 103, a battery 109, capacitors or fuel cells 114, instrument panel 28 and lights 29, 30, 30A, and two preferably aerodynamically streamlined rear view mirrors 26, 26A, protruding on both sides of the shield 25 like "ears", as shown in Figure 3. These ears may have a reinforced and strong structure and structurally may be part of the shield 25 to protect the driver's hands in case of a side slip and fall.

Additional protection of the driver may be provided by a roll bar 39. Both wheels 3 and 4 may have also well known flexible suspension with shock absorbers (not shown).

The performance of the vehicle is also enhanced by reducing the body weight. The body weight reduction may be achieved by using substantially magnesium metal for body frame 2 and seat frame 6A construction, which may be constructed of extruded magnesium metal alloy tubings, such as tubings 2A and 202 to 213 inclusive, preferably having square or rectangular sections, bonded together with an adhesive and the aid of various (preferably magnesium) metal joint fittings 214 to 223 inclusive, as shown in Fig. 10, and which is another embodiment of the invention; or said frame and seat frame are

welded together, such as by weld 224, as shown in Fig. 11, and which is another embodiment of the invention. The fittings are understood to be structural elements for joining ends of tubes at their intersection points by sliding into or over the tubings or may be threaded.

In addition, the wheels 3 and 4 and preferably three spike wheels may have also magnesium alloy hubs, spikes and rims.

It is apparent to a person skilled in the art, that said body frame, seat frame and wheel construction, as described, is useable also in many other two wheeled electric vehicles.

A further weight reduction may be achieved by using the ultrahigh molecular weight polyethylene fibers with a resin in a composite 225 or in a composite sandwich 226 construction, with a paper, and preferably a fire retardant paper honeycomb core 227, for the front shield 25 construction and for other body covers or panels construction, as shown in Fig. 12, which is another embodiment of the invention. The front shield and other covers may be referred to simply as "body panels" and should be attached to the body frame or components which they cover.

The front shield and other panels or covers may be also constructed from molded plastic, and preferably lightweight polyethylene sheets 228 and 229, and are preferably "double-walled" and welded, with a hollow space 230 therebetween, as shown in Fig. 13, which is another embodiment of the invention.



It is apparent to a person skilled in the art, that all the above weight and drag reductions contribute to a longer range of said vehicle, as compared to other prior art two wheeled electric vehicles, even when having an identical prior art propulsion systems, equipment and payload.

Both materials, the magnesium and the ultrahigh molecular weight polyethylene with the honeycomb core composite sandwich construction, as well as the plain polyethylene double wall construction increase the safety, because they have the highest energy absorption and vibration damping characteristics of all known materials. This unique combination also contributes to a quiet ride of the vehicle. The fire retardant paper honeycomb may be made from a recycled paper economically, and the magnesium metal and polyethylene are also easily recyclable.

All described magnesium components may be protected from corrosion by well known design rules recommended for magnesium and by synergistic fluoropolymer coatings, such as made by General Magnaplate Corp., Linden, NJ., or anodic oxidation coatings, to overcome low corrosion resistance of magnesium.

The propulsion system comprises, at least one electric motor 31 behind the seat 6, which may have preferably copper disc clutch 200 (which may be controlled by the driver by well known means,) and a reduction drive 32 driving preferably larger rear wheel 4 through a timing belt 33 and pulleys 33A and 33B.. At least one battery or batteries 96 and 97 are preferably mounted under the seat 6, or on both sides of the

rear wheel 4 (not shown), very low to keep the center of gravity of the vehicle low. The clutch 200 protects the motor and the batteries from an electric surge load during acceleration from standing or other shocks, and the copper material provides for long wear life. The electric motor may be controlled by a variable speed controller 27, attached to the feet rest platform 8, or it may be attached to the motor 31 (not shown), or to other components. Accelerator, electrically connected to the controller 27 may be a potentiometer 34 turned by a cable from a "wrist-twist" of the handle 14. There is no "shifting" of speeds involved. Other electrical components like electronic boards, relays, breakers, switches, fuses and distribution blocks may be mounted in electrical box 38 preferably behind the seat.

In addition to this "electric-only" drive, there is optionally provided at least one additional power system, comprising small internal combustion engine 87, which may be a piston type reciprocating engine, rotary piston type, or a turbine, which is driving an electric current generator 104, which may be an alternator with rectifier and voltage regulator for charging the batteries 96 and 97. The generator 104 may replace the engine flywheel to reduce the total weight and may have a clutch 250 enabling the engine to start without the generator load. This results in a smaller, lighter and less consuming engine. The engine/generator unit may be mounted on a rack or shelf 35, behind the driver's seat 6 and above the rear wheel 4, and may be enclosed by an aerodynamic end cover

enclosure 37. The shelf 35 is supported by braces 36 and 36A. The aerodynamic end cover enclosure 37 may be also sound-proofed to reduce the engine noise. It is preferred to have the engine on the very end of the vehicle for the same reason, and because the engine is usually lighter than the generator. This additional power back-up system provides for electric-hybrid vehicle and serves as a mileage extender, or as a main cruising power supply, with batteries used only for acceleration and extra power for hill climbing. The generator should be designed for cruising power, plus extra for charging of the batteries during a level cruising, and for other loads. However, it is possible to drive this vehicle a shorter distance only on battery power, as a "stealth" vehicle.

To make this engine or turbine non-polluting, it should be fueled preferably by hydrogen, contained in the tank 103, which tank may also contain a metal hydride of well known type. There is a great advantage in using an electric hybrid fueled by hydrogen, because the engine is approximately one third of the size required for combustion-only driven vehicle. That means, the electric-hybrid has approximately three times longer range per the same amount of hydrogen. Because compressed hydrogen storage is very bulky and heavy, prior art hydrogen powered vehicles have very limited range, similar to electric-only vehicles. The electric-hybrid vehicle configuration fueled by hydrogen makes the hydro-electric vehicle of the invention competitive with gasoline fueled, combustion-only

vehicles, and is non-polluting. It should be noted that the negligible amounts of NO<sub>2</sub> generated can be captured by a catalytic converter 201.

Since the use of hydrogen as a fuel requires precautions, it may be produced for safety reasons on demand only, by electrolysis of water, which may be produced by action of the electric current generator 104, or the hydrogen may be produced by other sources.

If electrolysis of water is used, then the hydrogen tank 103 may be replaced (or assisted) by a hydrogen generating cell 105 of well known type, which may be electrically connected to the generator 104. Said water may have also an antifreeze agent added.

The hydrogen generating cell 105 may be also electrically connected to a battery 109, and/or to the batteries 96 and 97, to start the system operating and also for vehicle acceleration when the demand for fuel is high. The batteries may be recharged by the generator 104 during low power cruising or standing.

A simplified schematic illustrating the principles of the system is shown in Fig. 6, which is another embodiment of the invention. Switches or relays 110, 111, 112, 115 and 116 and valve 113 control the system functions as desired.

Referring now to Fig. 6 in more detail, the simplified operation of the system is as follows:

To start the engine 87 running, the switch 111 or switch

116 is turned "ON", which delivers direct electric current from the battery 109 or from the batteries 96 and 97 (if they still have some electric energy stored in them), to the hydrogen-oxygen generating cell 105, which produces hydrogen and oxygen gases and said gases are delivered into the combustion chamber of the engine 87. The engine 87 is simultaneously being cranked either manually or by its own cranking battery with a starter (not shown). Because the hydrogen fuel and air, plus oxygen are being delivered into the engine, the engine starts running and also driving the generator 104. When the switch 110 is turned "ON", the direct electric current from the generator 104 is delivered to the cell 105 and adds to, or replaces the current from the batteries 109 or 96 and 97. Then the switches 111 and/or 116 may be turned "OFF", which will disconnect the batteries from the cell 105.

If it is desired that the cell 105 is to be used to assist only to the delivery of the fuel, then the engine 87 may be started as follows:

During cranking of the engine 87, all the switches shown are turned "OFF", but the valve 113 is opened, which delivers stored hydrogen fuel from the tank 103 into the combustion chamber of the engine 87 and the engine starts running and driving the generator 104. When the switch 110 is turned "ON", the electric current is delivered to the cell 105, which starts producing hydrogen and oxygen gases and said gases are delivered into the engine 87, supplementing or replacing the

hydrogen fuel from the tank 103. Then the valve 113 may be closed. The batteries 109, 96, and 97 may be also recharged by the generator 104 when the switches 115 and 112 are turned "ON".

All the above described functions can be automated and controlled by an electronic controller (not shown) and all the switches may be replaced by relays.

All the "negative" or all the "positive" wires may be replaced by an electrically conductive frame or chassis.

All of the above propulsion systems preferably use hydrogen as a fuel, but many other fuels are available, such as natural gas, propane, methane, or methanol.

It is obvious to a person skilled in the art, that the described hydrogen generating and the additional power generating system is useable also in many other two wheeled electric and/or electric hybrid vehicles.

While any suitable type of electric motor is useable, the preferred electric motor 31 or motors for the vehicles of the invention are the disk armature design type motors, as manufactured by PMI Motion Technologies, Division of Kollmorgen Corporation, Commack, New York, U.S.A., and as shown in Fig. 14 and 15, which are another embodiments of the invention. These motors may have neodymium iron boron magnets (Nd Fe B) 31A, as manufactured by SPS Technologies, Newtown, Pennsylvania, U.S.A., and a disk armature 31B, and may have also magnesium casings 31C.

Although the electric vehicles of the invention may use almost any type of rechargeable battery, the preferred batteries are lithium rechargeable batteries and more preferably, lithium-ion-polymer rechargeable batteries, or hydrogen based rechargeable batteries, as described in my patent application Serial No. 08/583,383.

The batteries and/or the engine/generator unit of the vehicle of the invention may be also replaced by at least one capacitor and/or by at least one electricity generating fuel cell system, which may replace at least one battery or all the batteries or the engine/generator in the described locations, or the vehicle may have an additional fuel cell system 114 to assist or charge the batteries.

The preferred fuel cell systems for the vehicles of the invention are the hydrogen/oxygen type, the hydrogen/air type and/or their combinations, but more preferred fuel cell system is the water based fuel cell system as described in my prior disclosure document of invention Serial No. 323,492, which water based fuel cell system is safe and economical.

The preferred tires for the electric vehicle of the invention are lightweight, pressure-airless tires with flexible honeycomb core as described in my prior U.S. patent #5,494,090. These tires are safer because they are puncture-proof and damage resistant and they also have low rolling resistance and thus further reduce the drag on the vehicle.

Because the batteries are usually the weakest components

in an electric-hybrid vehicle, at least as the useful cycle life is concerned, they should be protected from overdischarge and overcharge to extend their life. Prior art electric vehicles have unprotected batteries or cells connected only in series. Referring now to Fig. 7, illustrating a simplified wiring schematic of the batteries protection of the vehicle of the invention, and the preferred components to accomplish it, and which is another embodiment of the invention. The simplified operation and description of the system is as follows:

For example, the vehicle 1 has two batteries 96 and 97 connected in series to supply the electric current to 24 volt motor 31, through the motor controller 27, which receives a setting input from potentiometer 34 and which is adjusted by the driver 5. This part of the system may be turned "ON" or "OFF" by the main switch 40. To recharge the batteries 96 and 97, the generator 104, driven by the engine 87, is provided. The generator 104 may be a multiple generator containing two 12 volt generators 104A and 104B preferably on the same shaft, which are connected electrically in parallel to individual batteries 96 and 97, as shown. Each battery has its own assigned and wired as shown monitoring and controlling unit (C.U.) 41 and 42, such as manufactured by PHOTRON, Willitis, CA, sensing individually each battery's energy level and voltage. For example, when battery 96 is fully charged to predetermined and preset level, the control unit 41 will



disconnect the generator 104A from the battery 96 by relay 43, controlled by control unit 41. Similarly and independently, the battery 97 is protected from overcharge by control unit 42 with relay 44. By another words, the batteries are independently, individually charged in parallel and individually disconnected from charging when charged to predetermined and preset energy level or voltage, and thus protected from overcharge.

When batteries 96 and 97 are discharged together in series to deliver 24 volts to the motor 31, each battery energy level is again individually monitored by control and sensing units 41 and 42. If one of the two batteries reaches the predetermined and preset low (discharged) limit, that battery's control unit will disconnect the discharging circuit by relay 45 or 46.

Due to inevitable variation in individual batteries capacity, the "weaker" battery is discharged first, causes the load to disconnect and is thus protected from overdischarges, including the other "stronger" battery.

It is apparent, that this described circuitry can be expanded for any amount of batteries or cells in series, for any voltage system, and may have several low voltage generators (or alternators) preferably on the same shaft, matching the voltage and quantity of the batteries or cells. Also, the multiple generators may be similarly replaced by multiple fuel cells, or multiple fuel cell stacks.

For example, lithium-ion batteries require protection of every 3.7 volt cell from overcharge or overdischarge, also for

safety. The individual cells or batteries when discharged, may be also individually disconnected and by-passed, while the remaining cells or batteries continue to be discharged to preset limits. It is also apparent, that above described batteries protection is useable in many other electric vehicles and is applicable for any type of batteries.

Referring now to Fig. 4, which discloses another embodiment of the invention, an alternate two-wheeled electric vehicle 47 is illustrated, which may have a slightly modified frame 48, with simplified steering, having "T-bar" handlebars 49 and vertical torsional tube 50 connected directly to the front wheel fork 12.

The engine 87 with generator 104 in a cover 51 may be placed on one side of the rear wheel 4, lowering thus the center of gravity of the vehicle and permitting the shelf 35 to be used for carrying a baggage, or other components of the vehicle.

The vehicle 47 may also have two optional, lockable but retractable side legs 52 and 52A with very small wheels, to prevent the vehicle from falling during standing without the driver 5, or during standing, with the driver's feet on the platform 8. Deployment and retraction of the legs 52 and 52A may be fully automated by well known electromechanism, similar to landing gear of an airplane, and may be controlled by a switch mounted on handlebars 49. The legs 52 and 52A should not be wider than the mirrors 26 and 26A and ~~should be~~ retracted during

cruising.

The other features or components of the vehicle 47 may be identical to those as shown for the electric vehicle 1, as described above.

Referring additionally to Fig. 5, another embodiment of the invention, two-passenger two wheeled electric vehicle 53 is illustrated, which has an extended and stronger body frame 54 with an additional seat 55, and which vehicle carries also the second passenger 57. The feet of the second passenger 57 rest on two stands 56 and 56A, which are attached to both sides of the frame 54.

The vehicle may have also two additional batteries 59 and 60 mounted on both sides of the rear wheel 4, and a windshield 58. The seat 55 of the first passenger 5 should be narrower with narrow back support, to accomodate the legs of the second passenger 57 and should have a holding bar 55A. The other features may be identical to the electric vehicle 1 or 47, as described above.

Referring to Fig. 8, another embodiment of the electric vehicle 59 is illustrated. The vehicle 59 is recumbent electric hybrid moped, having modified, lengthwise adjustable frame 60 to accept the front mounted pedals 61 and 61A with cranks and sprocket 62. The sprocket 62 is driving a sprocket 64 at the rear wheel 4 through a long chain 63 and is assisting thus the motor 31D during hill climbing, or during an exercise ride. The sprocket 64 and pulley 33B should have well known

overdrive clutches. The motor 31D, optional generator 104C with engine 87A and batteries 96A and 97A may be smaller and the frame 60 may be lighter than similar components in previously described vehicles 1, 47, and 53. The front shield may be omitted, or can be made larger to accomodate the pedals (not shown). The rear view mirrors 65 and 65A may be mounted directly on handlebars 49. All other features may remain as described above for vehicle 1 or vehicle 47.

The vehicle 59 may be also referred to as an electric double hybrid, since it utilizes human power together with engine/generator, or fuel cells to assist the batteries driving the electric motor and the wheel 4. The advantage of this configuration is in having many times longer range than electric bicycles with batteries-only power, and thus providing longer exercise time to the rider, with more comfort and safety. This vehicle has also longer range per the same amount of hydrogen or other fuel stored, than above described vehicles, and possibly 600 miles per gallon of an equivalent to gasoline.

It should, of course, be understood that the description and the drawings herein are merely illustrative and it will be apparent that various modifications, combinations and changes can be made of the structures and the systems disclosed without departing from the spirit of the invention and from the scope of the appended claims.

It will thus be seen that a long range and safer electric

vehicle construction has been provided with which the objects of the invention are achieved.

I claim:

1. Electric vehicle construction which includes a body for carrying at least one passenger and an electric propulsion system with at least one electric motor and at least one battery attached to said body, and which body is riding on two wheels with a steering system attached to said body, and said body includes a body frame, a seat, a front foot rest platform, front and rear wheel, sides, front, rear, top and bottom, the improvement wherein

said passenger is seated in a reclining position with his feet resting on said front platform, above and in front of said front wheel, and said motor is mounted behind said seat and in front of said rear wheel.

2. Electric vehicle construction as described in claim 1, in which said batteries are mounted under said seat.

3. Electric vehicle construction as described in claim 1, in which at least one said battery is mounted on at least one side of said rear wheel.

4. Electric vehicle construction as described in claim 1, which is additionally provided with at least one electric current generator for charging said batteries and which is driven by an internal combustion engine and which generator with said engine is attached to said body frame behind said

seat and above said rear wheel.

5. Electric vehicle construction is described in claim 1, which is additionally provided with at least one electric current generator for charging said batteries and which is driven by an internal combustion engine and which generator with said engine is attached to said body frame on one side of said rear wheel.

6. Electric vehicle construction as described in claims 2 or 3, wherein at least one of said batteries is replaced with at least one electricity generating fuel cell system.

7. Electric vehicle construction as described in claims 2 or 3, wherein at least one of said batteries is replaced with at least one capacitor.

8. Electric vehicle construction as described in claims 4 or 5, in which said electric current generator is replaced with at least one electricity generator<sup>ing</sup> fuel cell system.

9. Electric vehicle construction as described in claims 4 or 5, in which said electric current generator is a multiple generator.

10. Electric vehicle construction which includes a body for

carrying at least one passenger and an electric propulsion system with at least one electric motor, at least one battery, at least one electric current generator for charging said battery and which is driven by an internal combustion engine, and a hydrogen storage system attached to said body, and which body is riding on two wheels with a steering system attached to said body. The improvement wherein said engine is an open to air combustion engine and is fueled only by said hydrogen.

11. Electric vehicle construction which includes a body for carrying at least one passenger and an electric propulsion system with at least one motor, at least one battery, at least one electric current generator for charging said battery and which is driven by an internal combustion engine, and a hydrogen generating cell attached to said body, and which body is riding on two wheels with a steering system attached to said body, the improvement wherein said engine is an open to air combustion engine and is fueled only by said hydrogen which is produced by electrolysis of water in said hydrogen generating cell, said cell is electrically connected to said generator and also to said battery, said hydrogen is not stored under pressure and is immediately consumed by said engine.

12. Electric vehicle construction which includes a body for carrying at least one passenger and electric propulsion system with at least one motor, at least one battery, at least one



electric current generator for charging said battery and which is driven by an internal combustion engine, a hydrogen storage system and a hydrogen generating cell by electrolysis of water, the improvement wherein said engine is an open to air combustion engine and is fueled only by said hydrogen, said hydrogen is supplied from said storage system and from said hydrogen generating cell, said cell is electrically connected to said generator, and said cell is also electrically connected to said battery.

13. Electric vehicle construction as described in claim 1, in which said batteries are lithium rechargeable batteries.

14. Electric vehicle construction as described in claim 1, in which said batteries are hydrogen based rechargeable batteries.

15. Electric vehicle construction as described in claim 26 or 27, in which said body frame is protected by synergistic fluoropolymer coating.

16. Electric vehicle construction as described in claim 1, wherein said vehicle motor includes a disc armature.

17. Electric vehicle construction as described in claim 1, wherein said steering system includes semi-wheel steering handlebars which may rotate around approximately horizontal

axis and are connected to said front wheel through a plurality of torsional elements, ~~at least one universal joint~~, levers, push-pull rods, pins and an approximately vertical front wheel fork, and said torsional elements are supported by bearings embedded in a support structure, and said structure is attached to said body frame, and said fork is supported by bearings embedded in said body frame, and said steering system is controlled by said passenger.

18. Electric vehicle construction as described in claim 1, wherein said steering system includes an approximately vertical fork of said front wheel and "T"-shaped handlebars with approximately vertical torsional element connected to said front fork, and said fork is supported by bearings embedded in said body frame, and said steering system is controlled by said passenger.

19. Electric vehicle construction as described in claim 1, wherein said front platform is horizontally adjustable.

20. Electric vehicle construction as described in claim 1, in which said front and rear wheels include hubs, spikes and rims of magnesium alloy.

21. Electric vehicle construction as described in claim 1, in which said electric motor is driving said rear wheel through a

timing belt and pulleys.

22. Electric vehicle construction as described in claim 1, in which said wheels include pressure-airless tires having flexible honeycomb core.

23. Electric vehicle construction as described in claim 1, in which said seat includes a frame formed substantially of magnesium extrusions.

24. Electric vehicle construction which includes a body for carrying at least one passenger and an electric propulsion system with at least one motor, at least two batteries, at least two generators for charging said batteries attached to said body, and which is riding on at least two wheels with a steering system attached to said body, the improvement wherein said batteries are protected from overcharge and overdischarge by charging said batteries individually by said generators in parallel and individually disconnecting said batteries when charged to preset limits, and discharging said batteries together in series and individually disconnecting said batteries when discharged to preset limits.

25. Electric vehicle construction which includes a body for carrying at least one passenger and an electric propulsion system with at least one motor, at least two battery cells, at

least two electric current generating fuel cells for charging said battery cells attached to said body, and which is riding on at least two wheels with a steering system attached to said body, the improvement wherein said battery cells are protected from overcharge and overdischarge by charging said battery cells individually by said fuel cells in parallel and individually disconnecting said battery cells when charged to preset limits, and discharging said battery cells together in series and individually disconnecting said battery cells and by-passing them when discharged to preset limits.

26. Electric vehicle construction which includes a body for carrying at least one passenger and an electric propulsion system attached to said body and which body is riding on two wheels with a steering system attached to said body, and said body includes a body frame, the improvement wherein said body frame is formed substantially of magnesium alloy extrusions joined together with aid of fittings and an adhesive.

27. Electric vehicle construction which includes a body for carrying at least <sup>one</sup> passenger and an electric propulsion system attached to said body and which body is riding on two wheels with a steering system attached to said body and said body includes a body frame, the improvement wherein said body frame is formed substantially of magnesium alloy extrusions joined together by welds.

28. Electric vehicle construction as described in claim 1, which includes retractable side legs with wheels and which side legs are attached to said body.

29. Electric vehicle construction as described in claim 1, 4 and 5, which additionally includes a front aerodynamic shield which is attached to and is partially enclosing said front platform, and a rear aerodynamic cover enclosure which is enclosing and is attached to said generator and said engine.

30. Electric vehicle construction as described in claim 29, in which said front shield and rear cover enclosure are of composite sandwich construction with ultrahigh molecular polyethylene fibers in a resin and a paper honeycomb core.

31. Electric vehicle construction as described in claim 29, in which said front shield and rear cover enclosure are of molded and welded polyethylene sheets of double wall construction with a hollow space there between.

32. Electric vehicle construction as described in claim 29, in which said front shield structurally includes streamlined and protruding rear view mirrors on both said sides of the vehicle.

33. Electric vehicle construction as described in claim 1, wherein said front platform is replaced by an additional pedal

drive, said pedal drive is horizontally adjustable and is driving said rear wheel.

34. Electric vehicle construction as described in claims 4 or 5 or 10 or 11 or 12, in which said generator includes a clutch, and said clutch enables said engine to start without the generator load.

Abstract of the Disclosure

An electric vehicle which carries at least one passenger and is riding on two wheels, said passenger is sitting in low, recumbent position and batteries or fuel cells are mounted under the seat and behind the seat. The vehicle has an aircraft type steering and aerodynamically shaped body with substantially reduced frontal area and drag. The body is lightweight, made from shock absorbing materials and structures, and has pressure-airless tires and other features, which enhance the safety of the passengers. The vehicle also includes an advanced, long range and non-polluting propulsion system fueled by safely stored hydrogen.





## United States Patent [19]

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[45] June 28, 1977

Dufour

[54] HYDROGEN-OXYGEN FUEL CELL FOR USE  
WITH INTERNAL COMBUSTION ENGINES[76] Inventor: Patrick Dufour, 14 Hawthorne St.,  
Laconia, N.H. 03246

[22] Filed: Oct. 1, 1975

[21] Appl. No.: 618,442

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123/DIG. 12[51] Int. Cl.<sup>2</sup> ..... F02B 43/08[58] Field of Search .... 123/1 A, 3, 119 E, DIG. 12;  
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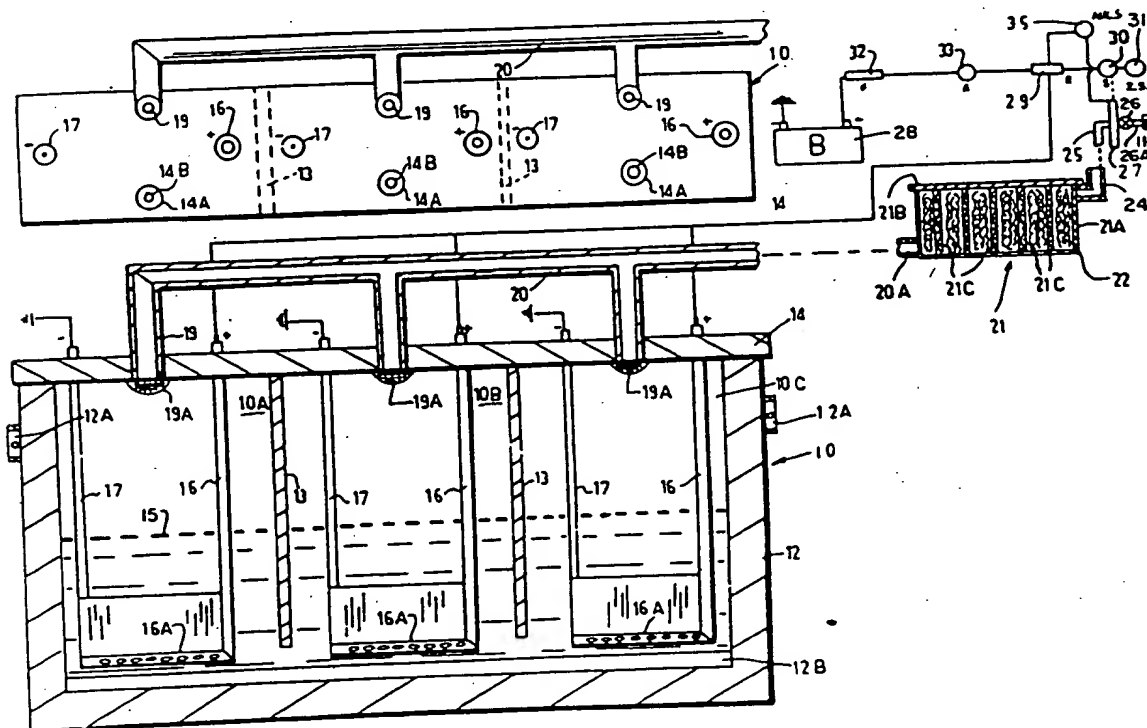
Primary Examiner—C. J. Husar

Assistant Examiner—Craig R. Feinberg

## [57] ABSTRACT

A fuel cell for generating a hydrogen and oxygen gas utilizing a water electrolyte and a catalyst selected from the group consisting of sodium hydroxide and potassium carbonate. The fuel cell includes a pair of electrodes connected in circuit with an electrical power supply and an outlet for directing the generated hydrogen and oxygen to a drier where it is dried and mixed to form a combustible fuel mixture. The fuel mixture is then directed in accordance to engine demand to the intake manifold of an internal combustion engine as a fuel supplement.

1 Claim, 1 Drawing Figure



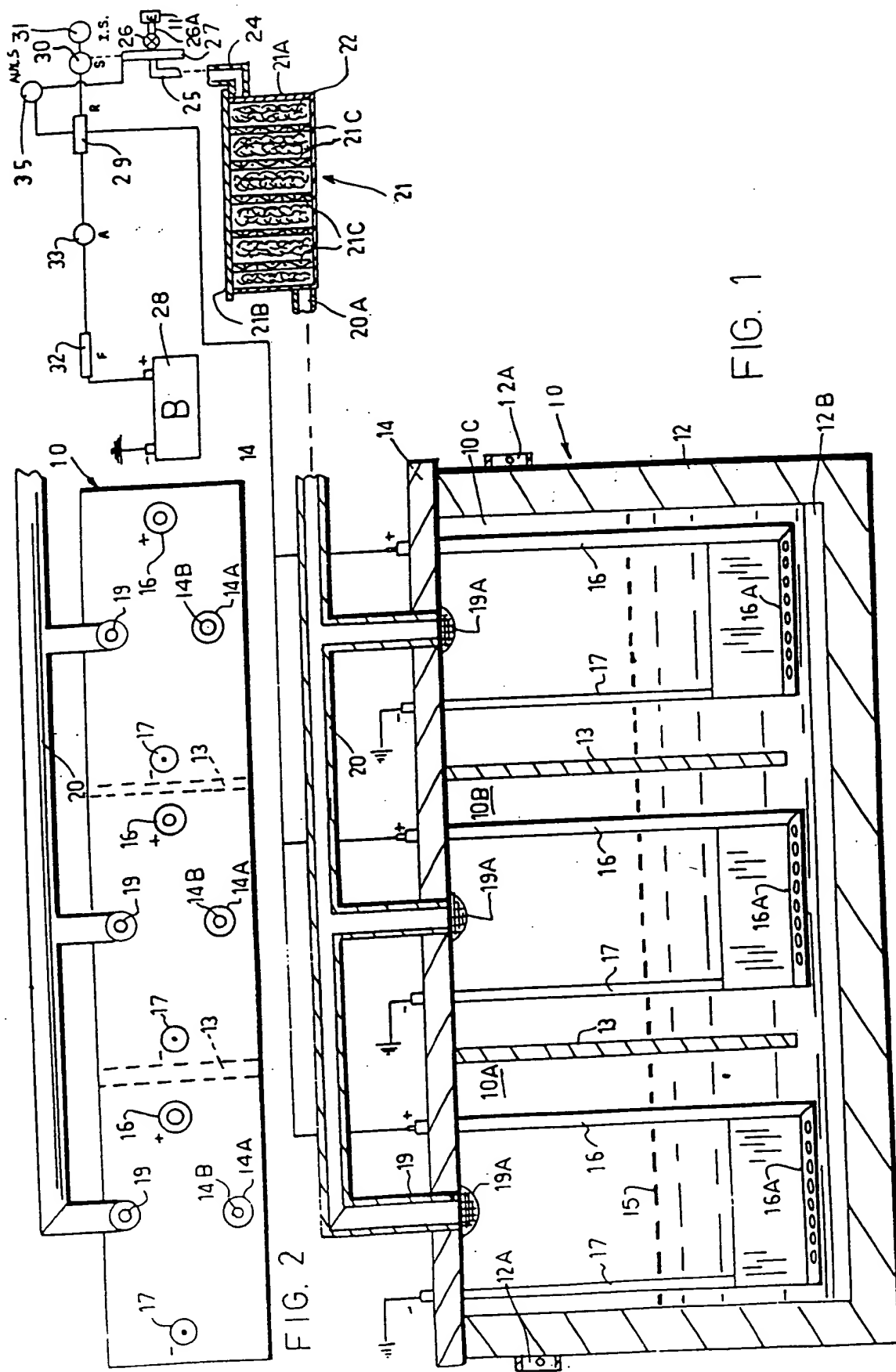


FIG. 1

FIG. 2

# HYDROGEN-OXYGEN FUEL CELL FOR USE WITH INTERNAL COMBUSTION ENGINES

## PROBLEM AND PRIOR ART

Heretofore, numerous efforts have been made to increase the mileage attainable from a gallon of gasoline, when such is used as a fuel for an internal combustion engine, e.g., in an automobile. The prior known effects comprised of utilizing various types of additives to the fuel prior to burning. Other efforts comprised of employing various devices for improving ignition and/or timing of the engine so as to achieve maximum efficiency. Other efforts have comprised of utilizing alternate or supplemental fuel. While various efforts have been disclosed in various publications for utilizing hydrogen gas as a fuel for internal combustion engines, it is not known whether any of such efforts have in fact been reduced to actual practice by others.

## OBJECTS

It is an object of this invention to provide a method and apparatus whereby hydrogen and oxygen can be generated by electrolysis from water containing a catalyst and whereby the generated gases can be mixed to form a combustible fuel mixture for use as a supplemental fuel in operating an internal combustion engine.

Another object is to provide a fuel cell for generating hydrogen and oxygen for use as a fuel for operating an internal combustion engine.

Another object is to provide a hydrogen generator or fuel cell wherein the amount of gases generated is proportional to engine demand.

## BRIEF SUMMARY OF INVENTION

The foregoing objects and other features and advantages of the invention as attained by generating by electrolysis of water a hydrogen and oxygen gas which are mixed to form a combustible mixture which is then fed to the intake manifold of an internal combustion engine which is operating on conventional fuels, in accordance with engine demand. This is attained by a hydrogen generator having one or more fuel cells. Each fuel cell includes a pair of electrodes extending into a water electrolyte having a catalyst, e.g., sodium hydroxide, dispersed therein. When utilized in a vehicle, the electrodes of the fuel cell are connected in circuit to the power supply of the vehicle. The generated gases are directed from the fuel cell to a dryer where the gases are dried and mixed to form a combustible fuel mixture. The fuel mixture is thereafter directed to the intake manifold of an internal combustion engine as a fuel supplement.

## IN THE DRAWINGS

FIG. 1 illustrates a fuel cell embodying the present invention and schematically shown as utilized in a vehicle.

FIG. 2 is a plan view of the fuel cell of FIG. 1.

## DETAILED DESCRIPTION

This invention is directed to a method of generating and supplying hydrogen gas as a fuel supplement to an internal combustion engine, and an improved hydrogen generator or fuel cell for generating the hydrogen gas. By supplementing the burning of a conventional fuel with hydrogen, the internal combustion engine in operation is capable of producing more work. The method

comprises of generating, by electrolysis of water, a hydrogen and oxygen gas. To enhance the electrolysis, a catalyst, e.g., sodium hydroxide or potassium carbonate is added to the water electrolyte. The hydrogen and oxygen so produced is dried and mixed to form a fuel mixture which is then fed to the intake manifold of an internal combustion engine. The rate of generation of the hydrogen and oxygen gas is controlled in accordance with engine demand.

Referring to the drawings, there is shown the improved hydrogen generator 10 for generating hydrogen and oxygen gas for use in a vehicle powered by an internal combustion engine 11, e.g., a gasoline engine, diesel or the like. It will be understood that the engine 11 comprises a conventional internal combustion engine utilizing ordinary gasoline as an operating fuel if it be a gas engine, or diesel oil if it is an diesel.

As shown, the hydrogen generator or fuel cell 10 includes a housing 12 having one or more partitions 13 to define a multi-chamber fuel cell 10. It will be understood that the fuel cell 10 may be constructed to have one or more cell chambers. The illustrated hydrogen generator or fuel cell 10 is thus shown as having three fuel cell chambers 10A, 10B, and 10C. The upper end of the fuel cell housing 12 is closed for a cover or closure 14. Mounting plates 12A are connected to the housing 12 for providing a means for clamping the hydrogen generator 10 to the frame structure of a vehicle.

Formed in the cover 14 to communicate with the respective chambers 10A, 10B and 10C is an inlet 14A closed by a filler cap 14B through which the respective chambers can be charged with an electrolyte. The filler cap 14B has a valve in it to compensate for any excess vacuum which is created when the engine is running.

In accordance with this invention the electrolyte comprises water 15. A catalyst is dispersed in the water 15. The catalyst comprises sodium hydroxide or potassium carbonate.

As shown in FIG. 1, the partitions 13 are spaced from the bottom of the housing so that the respective chambers 10A, 10B, 10C are in communication with one another. Also the bottom of the housing 12 is formed with ribs 12B running longitudinally of the housing 10. The ribs 12B thus enhance the flow of electrolyte from one chamber to the other. The arrangement is such that sediment chambers are formed at the bottom of the housing 12.

Extending into the electrolyte reservoir of the respective cell chambers 10A, 10B, 10C are a positive and negative electrode 16 and 17 respectively. The arrangement is such that when the electrodes are energized, the hydrogen and oxygen in its respective gaseous form is liberated. The positive electrode is also defined as an air tube which is perforated along the lower end 16A whereby the air causes agitation sufficient to stir or liberate the hydrogen forming at the electrode.

Extending through the cover 14 over each of the cell chambers 10A, 10B and 10C is a gas outlet 19 which connects with conduit 20 whereby the oxygen and hydrogen gases generated are directed to a dryer 21. A screen 19A is extended across the inlet 19 to prohibit foreign matter from entering conduit 20. As shown, the dryer 21 comprises a housing 21A and a cover 21B. Disposed in the housing of the dryer are a series of spaced copper screens 21C and a filter insert 22 is disposed between the screen 21C within the dryer to

effect a drying of the generated gases. Such filtering inserts may comprise steel wool, fiber glass, asbestos fiber, mica chips and the like.

In passing through the dryer, the moisture contained in the gases generated is separated therefrom. As shown in FIG. 1 the dryer is a separate unit connected by a conduit or hose 20A to the outlet 20 of the hydrogen generator 10 and it is located at a higher elevation relative to fuel cell 10.

The outlet 24 of dryer 21 connects by a conduit 25 to the inlet end of a control valve 26. The outlet 26A of the valve is connected to the intake manifold of the engine 11.

An actuator 27, e.g., an accelerator of a vehicle is operatively connected to the control valve 26 so that the latter is rendered responsive to the movement of the accelerator 27. The arrangement is such that the amount of gases introduced to the intake manifold of the engine is rendered proportional to engine demand or speed.

As best seen in FIG. 1, the negative electrode 17 as is the negative electrode of a battery 28 is grounded. The electrical circuit includes a relay 29 which when actuated controls a rheostat switch 30 to control the rate at which the gases are generated in the fuel cell 10. As seen in FIG. 1, the accelerator is connected to the rheostat switch 30 by a linkage so that as the engine speeds up and requires more fuel, more gases will be generated. The relay 29 in turn is also wired in circuit to an ignition switch 31. The usual fuse 32 and ammeter 33 is wired in circuit with the relay 29. An auxiliary switch with 35 light is in circuit between the accelerator 27 and the relay.

In operation, it will be noted that when the ignition switch 31 is closed the engine 11 can be started in the conventional manner. That is, gasoline is fed to a carburetor where it is mixed with air and the gas mixture fed to the respective cylinders where it is fired. With the fuel cell 10 connected in circuit as seen in FIG. 1, the actuation of the accelerator causes the fuel cell to generate hydrogen and oxygen gases which are then passed to a dryer 21 and then to the control valve 26 to the intake manifold of the engine. The hydrogen thus fed to the cylinder of the engine mixes with the conventional fuel thereby enhancing the energy level of the

fuel by the amount of energy contained in the hydrogen gases. With the hydrogen supplement it has been discovered that the miles attainable by an automobile engine per gallon of gas is considerably enhanced.

While the invention has been described with reference to an automobile engine, the principle can be applied to a stationary engine, diesel engine and in general to any type of internal combustion engine, and irrespective of the fuel customary for operating such engine.

As the invention has been described with respect to a particular embodiment and method, it will be understood and appreciated that variations and modifications may be made without departing from the spirit or scope of the invention.

What is claimed is:

1. In combination, an internal combustion engine having an intake manifold, and a carburetor for supplying a fuel-air mixture to said engine, a hydrogen and oxygen gas generator for supplying a hydrogen gas fuel supplement to said engine, said gas generator comprising a cell containing water, a negative and positive electrode extending into said water, a catalyst of an alkaline base dispersed in said water, an electrical D.C. power supply connected in circuit with said electrodes whereby hydrogen gas is generated when said electrodes are energized, a rheostat switch in circuit with said power supply to control the rate of said hydrogen gas generator, a dryer, conduit means connecting the gases generated in said cell to said dryer, means for directing the gases dried in said dryer to said intake manifold, and accelerator means operatively connected to said rheostat switch for controlling the rate of gas generation in accordance to engine demand, and wherein said positive electrode is perforated to permit the introduction of air into said cell to enhance liberation of the hydrogen gas forming at the negative electrode.

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EXPIRED  
1995

## United States Patent [19]

[11]

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[45]

Sep. 12, 1978

Laumann et al.

## [54] HYDROGEN-FUELED ENGINE

[76] Inventors: James C. Fletcher, Administrator of the National Aeronautics and Space Administration, with respect to an invention of Eugene A. Lauman, Pasadena; Rollin K. Reynolds, Tujunga, both of Calif.

[21] Appl. No.: 718,268

[22] Filed: Aug. 27, 1976

[51] Int. Cl.<sup>2</sup> ..... F02B 75/12; F02B 43/08

[52] U.S. Cl. .... 123/1 A; 123/3; 123/DIG. 12

[58] Field of Search ..... 123/1 A, 3, 119 A, 119 E, 123/DIG. 12; 204/129; 431/2, 4

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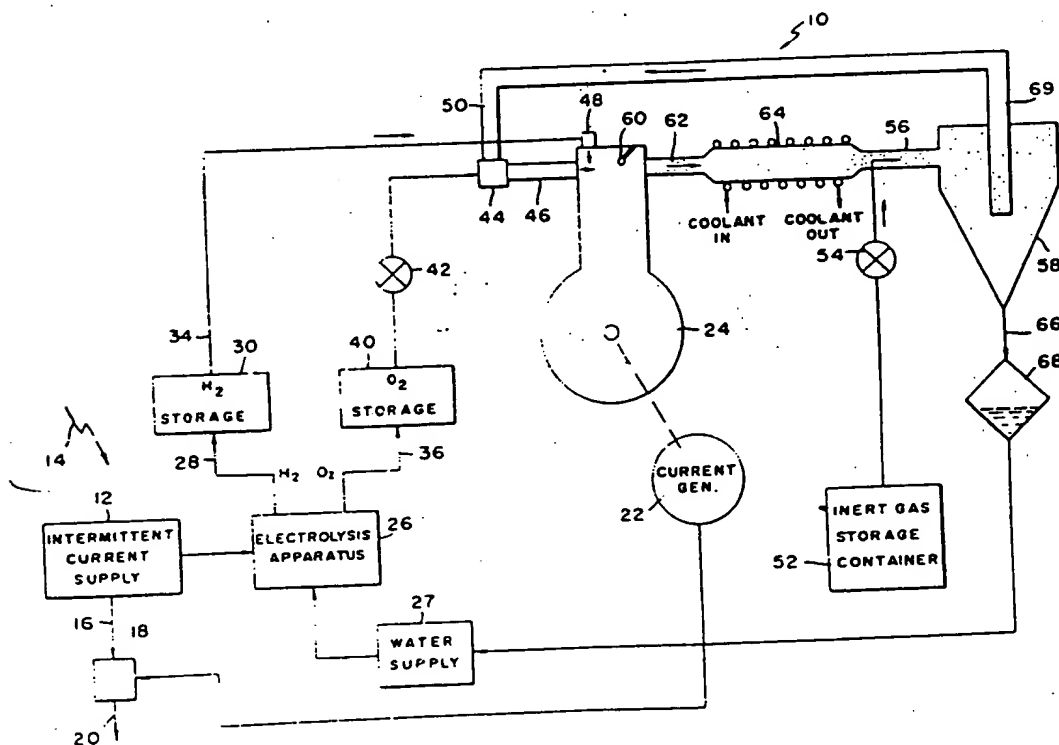
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Primary Examiner—Charles J. Myhre  
Assistant Examiner—Craig R. Feinberg  
Attorney, Agent, or Firm—Wilfred Grifka; John R. Manning; Monte F. Mott

## [57] ABSTRACT

A hydrogen-oxygen fueled internal combustion engine is described herein, which utilizes an inert gas, such as argon, as a working fluid to increase the efficiency of the engine, eliminate pollution, and facilitate operation of a closed cycle energy system. In a system where sunlight or other intermittent energy source is available to separate hydrogen and oxygen from water, the oxygen and inert gas are taken into a diesel engine into which hydrogen is injected and ignited. The exhaust is cooled so that it contains only water and the inert gas. The inert gas in the exhaust is returned to the engine for use with fresh oxygen, while the water in the exhaust is returned to the intermittent energy source for reconversion to hydrogen and oxygen.

6 Claims, 2 Drawing Figures



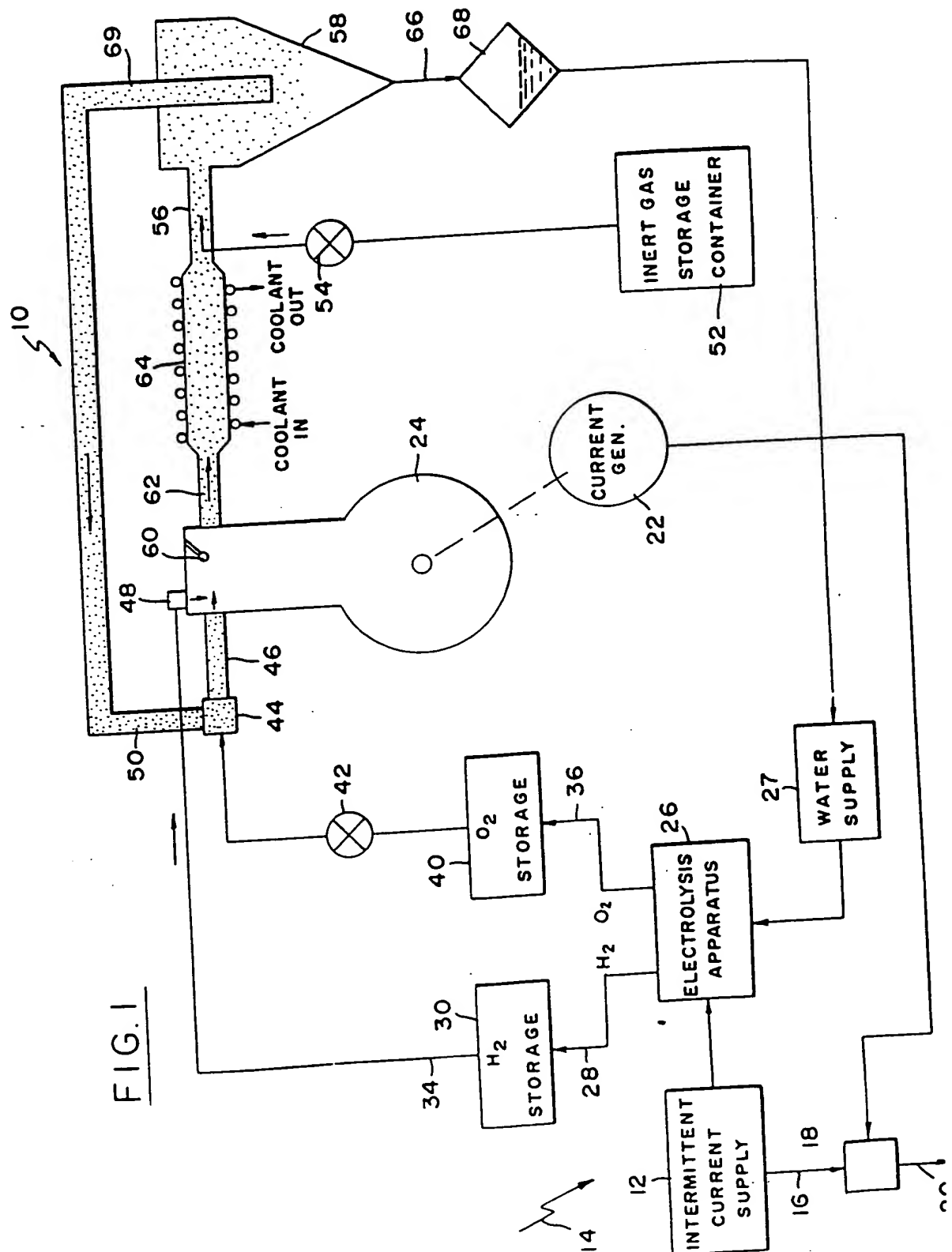
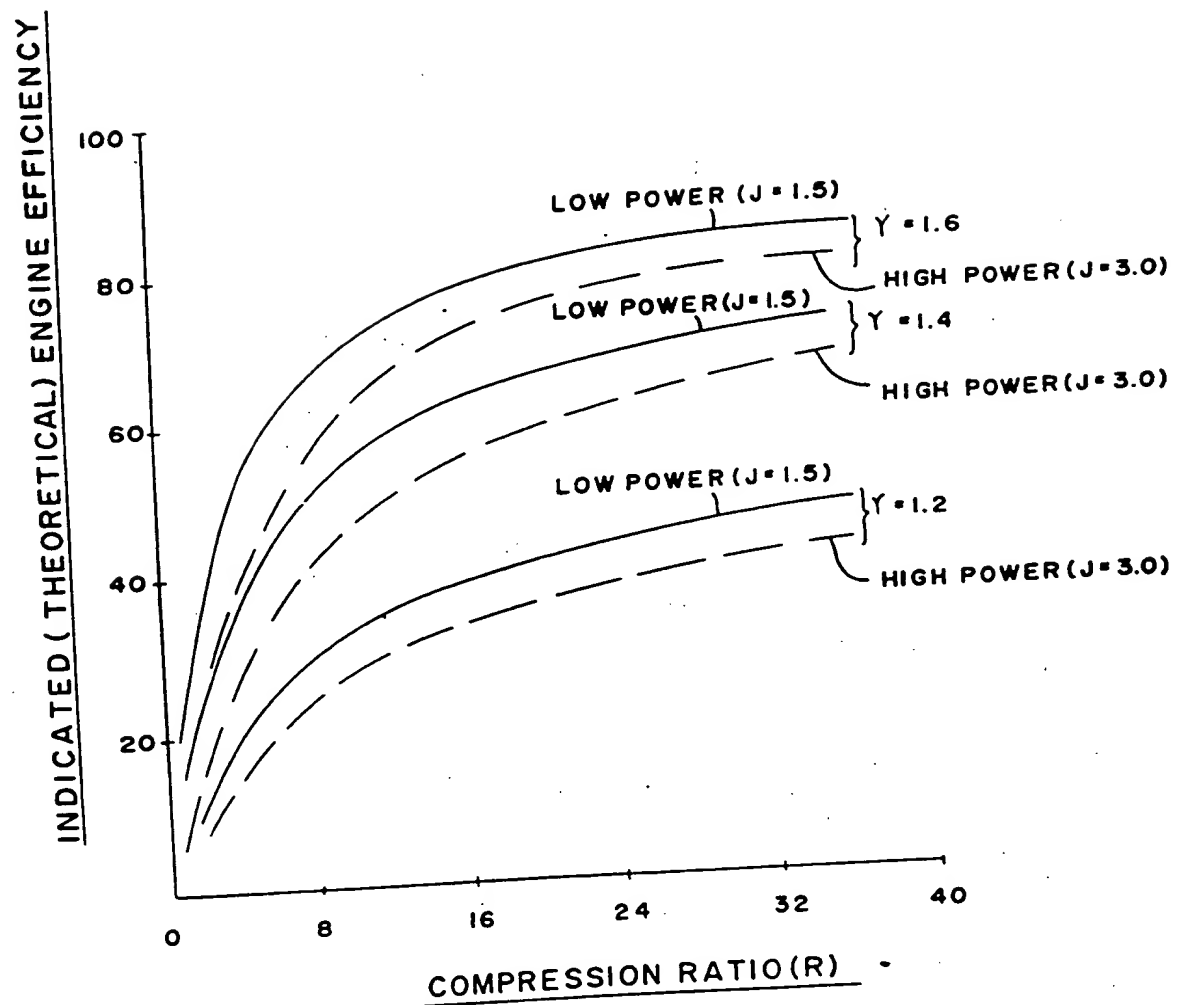


FIG. 2



# HYDROGEN-FUELED ENGINE

## ORIGIN OF INVENTION

The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 305 of the National Aeronautics and Space Act of 1958, Public Law 85-568 (72 Stat. 435; 42 USC 2457).

## BACKGROUND OF THE INVENTION

This invention relates to hydrogen fueled engines.

Considerable efforts have recently been directed towards utilizing intermittent natural power sources, such as sunlight, to generate hydrogen for use when power is not available from the natural source. Hydrogen can be utilized as the fuel in a diesel engine, in combination with air. However, if an engine with a high compression ratio is utilized to increase the efficiency of operation, then nitrous oxide pollution is generated. A system which substantially eliminated such pollution, while also providing greater efficiency in engine operation, would enable the production of mechanical or electrical energy at lower cost.

## SUMMARY OF THE INVENTION

In accordance with the present invention, a hydrogen-fueled energy system is provided which is of high efficiency and which produces substantially no pollution. The system includes an engine powered by hydrogen and oxygen, with an inert gas as a working fluid. The inert gas permits operation at very high thermal efficiencies for any given volumetric compression ratios. The exhaust of the engine contains substantially no pollutants, and can be cooled to separate liquid water from the working fluid. The working fluid can be returned to the engine, while the water can be utilized in the production of hydrogen and oxygen.

The novel features of the invention are set forth with particularity in the appended claims. The invention will be best understood from the following description when read in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a simplified diagram of a closed cycle, hydrogen-fueled energy system, constructed in accordance with the present invention; and

FIG. 2 is a graph showing the theoretical efficiency of hydrogen-fueled engines.

## DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 illustrates a closed cycle energy system 10, which is based on the use of hydrogen as a fuel. The system includes an intermittent current supply 12 in the form of a bank of solar cells which receives sunlight 14 and converts it to current. During sunny days, the supply provides current over line 16 which flows through a switch 18 to an output line 20 for transmission to electricity users. On very cloudy days and at night, current is supplied through the switch 18 to the output line 20, by a current generator 22 which is driven by a diesel engine 24. During sunny days, the intermittent supply 12 also supplies current to an electrolysis apparatus 26 which receives water from a water supply 27 and separates the water into hydrogen and oxygen. The hydrogen is delivered over line 28 to a hydrogen storage device 30 which can supply pressured hydrogen on

its output line 34. An oxygen outlet 36 of the electrolysis apparatus delivers oxygen to an oxygen storage device 40 which supplies pressured oxygen. The oxygen supply 40 delivers the oxygen through a control valve 42 to a carburetor 44, and the outlet 46 of the carburetor is connected to the engine 24 to supply oxygen thereto. At the same time, hydrogen from the hydrogen supply outlet 34 is delivered to an injection valve 48 which injects the hydrogen into the engine 24.

In accordance with the present invention, the working fluid, an inert gas, is supplied through a pipe 50 to the carburetor 44 to mix with the oxygen therein, so that a mixture of oxygen and the inert gas is supplied from the carburetor outlet 46 to the engine. The inert gas is initially supplied from an inert gas storage container 52 through a control valve 54 to a pipe 56 which leads to a separator 58, the inert gas in the separator 58 flowing through the pipe 50 to the carburetor 44. The proportion of inert gas, of the oxygen-inert gas mixture, is preferably great enough to constitute a majority of the mass of the mixture, and in any case should constitute more than 10%, by weight, of the oxygen-inert gas mixture.

The invention can better be understood by following the complete cycle of operation as illustrated in FIG. 1. The diesel engine 24 receives a mixture of oxygen and inert gas from the carburetor 44, and receives injected hydrogen from the injector valve 48. A glow plug 60 assures combustion of the hydrogen and oxygen to produce high pressures that move the pistons of the diesel engine. An exhaust 62 of the engine carries away the products of combustion, which includes the combined hydrogen and oxygen, in the form of steam, some residual oxygen, and the inert gas. The exhaust moves through a cooler 64 which cools the exhaust so that the steam condenses to liquid water. The exhaust passes through the pipe 56 to the separator 58, where the water falls through an outlet 66 into a gathering tank 68 which leads back to the water supply 27. The inert gas 69 in the separator 58 remains gaseous, and passes through the pipe 50 to the carburetor 44 for reuse. The inert gas storage container 52 makes up for losses of the inert gas by supplying small quantities to the system. The water in the water supply 27 is supplied to the electrolysis apparatus 26 so that it can be separated into hydrogen and oxygen for reuse in the engine. Any uncombusted oxygen and/or hydrogen is returned with the argon, through the pipe 50 for reuse. If significant amounts of carbonates or unreacted hydrocarbons are present in the exhaust (due to lubricating oil in the engine) then the carbonates and light hydrocarbons can be removed with an absorption filter and the heavy hydrocarbons can be filtered out of the water. Excessive hydrogen can be removed with a catalyst, or less hydrogen can be injected into the engine to account for hydrogen in the exhaust. Normally, a substantially stoichiometric ratio of hydrogen to oxygen is passed into the engine, although some excess oxygen can be admitted to help achieve complete combustion, the excess oxygen not being wasted since it is recycled.

The usefulness of the inert gas arises from the fact that the proper selection of the inert gas permits operation of the engine at higher thermal efficiencies than otherwise possible, and with no pollution of the atmosphere.

If it were possible to operate a diesel engine at conventional compression ratios, utilizing only oxygen and hydrogen at complete combustion, then excessive tem-



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within the engine in which the hydrogen is combusted. The inert gas is chosen so it has a large specific heat ratio of about 1.6 or more, and is inert in the presence of oxygen and hydrogen at a typical combustion temperature on the order of 3000° C to avoid the generation of pollutants. An especially appropriate inert gas is argon. This fueling arrangement enables the provision of a relatively simple closed cycle energy system, wherein the exhaust can be cooled to produce water and the inert gas, which are easily separated and which each 10 can be recycled for reuse in the engine.

Although particular embodiments of the invention have been described and illustrated herein, it is recognized that modifications and variations may readily occur to those skilled in the art and consequently it is 15 intended that the claims be interpreted to cover such modifications and equivalents.

What is claimed is:

1. A method for operating a hydrogen-fueled internal combustion engine comprising: 20  
introducing a mixture of oxygen and a working fluid into the cylinder of said engine;  
compressing said mixture; and  
injecting hydrogen into the cylinder, to combust the oxygen and hydrogen; 25  
a majority of said working fluid consisting of a noble gas.
2. The method described in claim 1 including:  
cooling the exhaust of said engine to convert the steam to water, and returning the gas in the cooled 30 exhaust to the cylinder of said engine.
3. A method for operating a closed cycle energy system comprising:  
separating hydrogen and oxygen out of water; 35

delivering oxygen and a monatomic inert gas to the combustion chamber of an engine;  
compressing the oxygen and inert gas in said chamber; 40

injecting hydrogen into said chamber when the oxygen and inert gas therein are compressed, to raise the gas pressure, and then produce work while lowering the pressure;

cooling the exhaust gas from said engine to produce water and said inert gas, for reuse in engine operation.

4. A method for operating a hydrogen-fueled engine comprising:

introducing into a combustion chamber oxygen and an inert monatomic gas that is inert in the presence of oxygen and hydrogen at a temperature of 3000° C.;

compressing the oxygen and inert gas in said combustion chamber;

injecting hydrogen into said combustion chamber at a time when the oxygen and inert gas therein are compressed, and allowing said hydrogen to ignite; exhausting the gas in said combustion chamber; and extracting inert gas from the exhaust gas.

5. The method described in claim 4 wherein: said inert gas comprises primarily argon.

6. The method described in claim 4 wherein: said oxygen and hydrogen are introduced into said combustion chamber in a substantially stoichiometric ratio; so that the exhaust consists substantially of water and inert gas; and including

separating the water and inert gas in said exhaust and separating the water into oxygen and hydrogen. 45

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FIG. 1

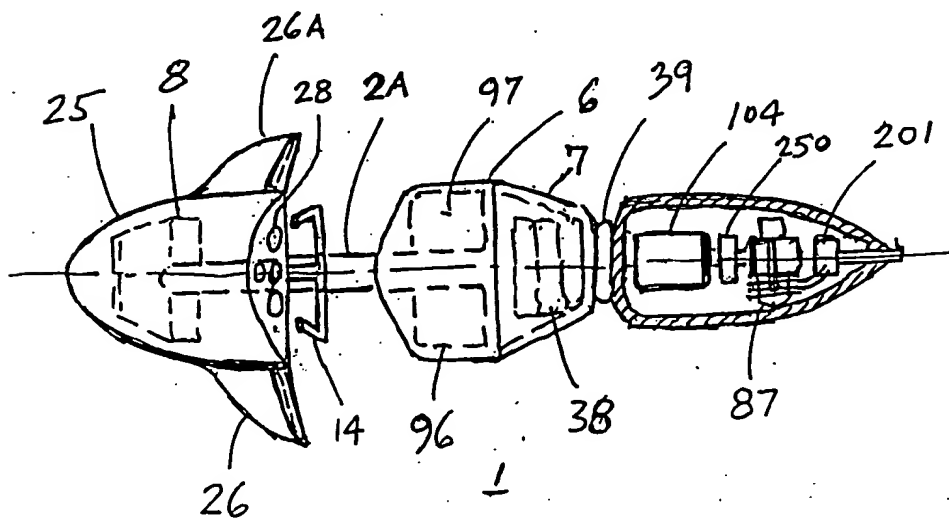


FIG. 2

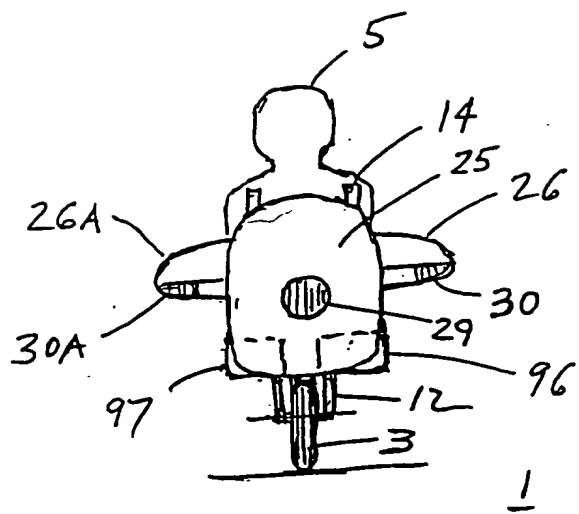


FIG. 3

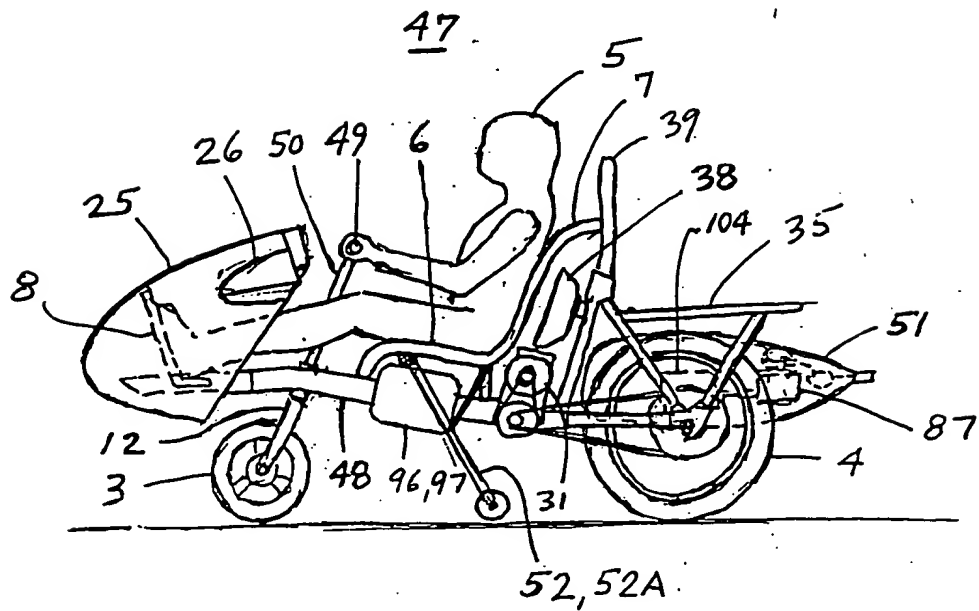
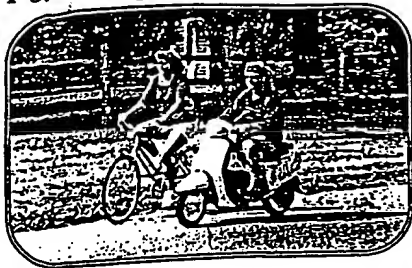
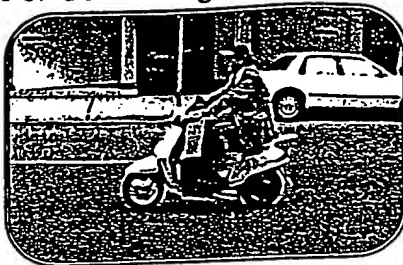


FIG. 4

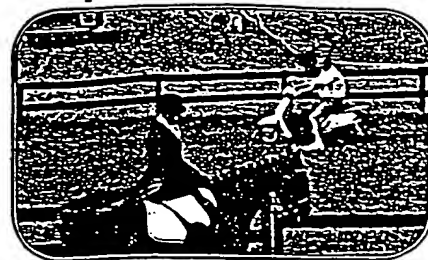
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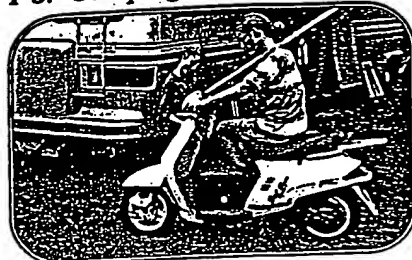
### For Commuting...



### For Sporting Events...



### For Camping...



### For Industry and Security...



### For School...



When you need quiet transportation, *Sol Gato Sun Cat II* electric motor scooter gives you all the quiet that you want. The hefty 2 hp battery-operated motor generates quick pick-up and speeds over 30 mph without any of the noise. And because there aren't any carburetors, spark plugs, or pistons and cylinders, there isn't any maintenance nor tune-ups. *Sol Gato II* is always ready to go. Just plug in the cord at night, and for pennies the scooter will give 25 miles before needing additional charge. Listen to the sounds of the country, without making any sounds of your own, and of course, without making any emissions of your own.

Electric vehicles may be the future for all travel, but two wheeled electric travel is here now. Proven reliable over four years since its introduction, *Sol Gato II* and its electric technology is so simple that little can go wrong. It requires no more maintenance than a bicycle and it is just as easy to drive since there is no clutching. Imagine, totally smooth and continuous torque from a stationary start to a hair standing 30 mph with no shifting!

#### HOW IT WORKS:

The 2 hp power plant is the latest technology series-shunt type DC motor. Actually, the technology is quite old and dependable. This motor represents small breakthroughs in price, size, and efficiency. DC motors are powered by batteries much like car batteries. Automobile batteries are constantly charging as the car travels and therefore maintain an almost constant level of charge. The *Sol Gato II* batteries are intermittently charged and go from full charge to deep discharge on almost every trip. Deep cycle batteries are made to different specifications than ordinary automobile batteries. *Sol Gato II* uses two compact, 12 volt deep cycle batteries available from any battery store by specifying type 22NF. As

new battery technologies are expected in the near future, they will fit the *Sol Gato II* battery box, and will increase the range well over the current 25 miles. The 24 volts from the battery is delivered to the motor in ever increasing voltage increments during acceleration. The controller of the applied voltage is a sophisticated electronic package called a motor controller. By twisting the throttle, the rider sends a signal to the controller to increase the voltage output to the motor, causing rapid acceleration. The motor controller in *Sol Gato II* is very dependable since it is used also for the electric golf cart industry. The motor drives a chain which is coupled to the rear wheel. The rear wheel is suspended from the body through a shock absorber, giving a soft ride.

*Sol Gato II* comes complete with speedometer (kilometers/hr), odometer, running lights, head lights with both low and high beam, turn signals, and horn. 110 v battery charger with plug-in cord is located in compartment under the seat. Keyed switch features OFF, ON, and LOCK positions. Key also unlocks storage cabinet in steering column.

As a *Sol Gato* owner you have use of our 800 hotline to get in touch with a technician any weekday from 8:00AM to 4:00PM EST for customer service or technical assistance. Also you will receive periodically the *Sol Gato* catalog of products, parts, and accessories.

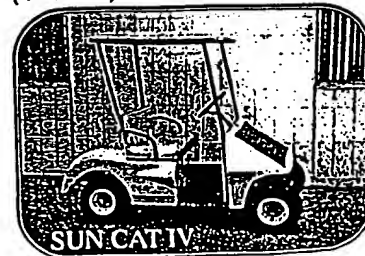
#### Another Sol Gato Product... (3 Wheel)...



#### SUN CAT II ACCESSORIES:

BASKETS: saddle bag (SC-050) and upright (SC-051)  
SECURITY LOCKS: SC-074  
SOLAR CHARGING STRIP: SC-078  
SOLAR GATO Photovoltaic Charging Station: SC-015

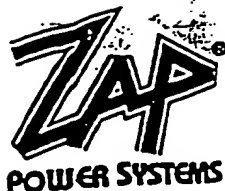
#### Another Sol Gato Product... (4 Wheel)...



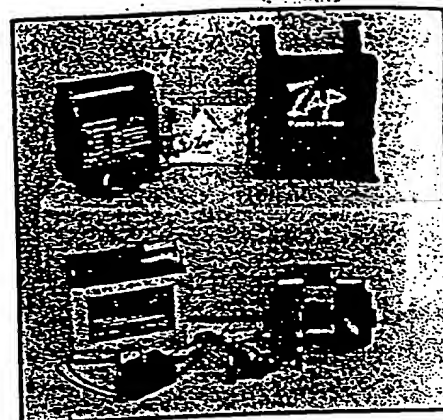
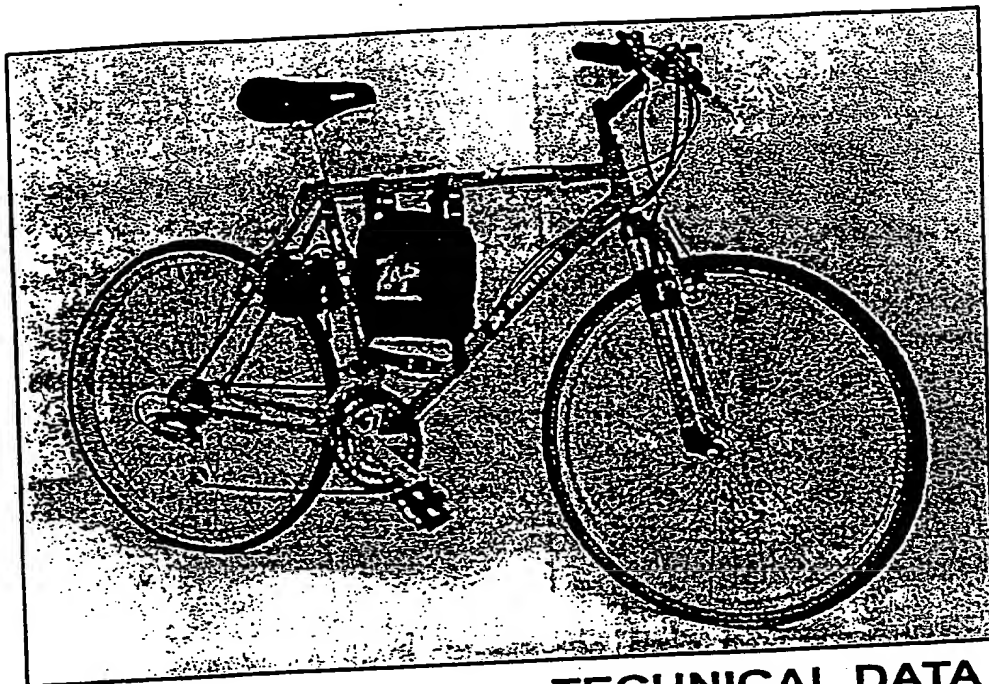
SUN CAT MOTOR COMPANY 4730 W. BANCROFT TOLEDO, OH.

DIV. James Kaum TECHNOLOGIES, Inc.

1-800-676-3013



# PowerBike™



## ZAP Power System

*Ready to install on your bike.*

### COMPLETE WITH:

- Dual permanent magnet ceramic drive motors.
- 3 speed controller with regenerative function.
- 17 amp hour battery (33 amp hour optional).
- Automatic charger.
- Switches, wiring and mounting hardware.

This system can be added to your bike to transform it into a clean running, power-assisted, fun machine. It can be mounted on most bikes.

**SHIPPING WEIGHT:** 27 lbs.  
One Year Limited Warranty.

## TECHNICAL DATA

**ITEM:** P-Bike (PowerBike™).

**FRAME:** Tange chromoly.

**BRAKES:** Shimano.

**SADDLE:** Super Soft.

**GEARS:** 18 speed Shimano index shifting.

**SUSPENSION:** Fastrax dual-damped system.

**HANDLEBARS:** Comfort Style.

**TIRES:** Semi-slick road.

**DRIVE SYSTEM:** ZAP Power System ZPS-BDR.

**MOTORS:** Dual, high efficiency, ceramic, permanent magnet direct current motors. 400 watt peak output. Weight is seven pounds.

**REGENERATIVE FUNCTION:** The patented motors can help recharge the battery on descents, when engaged during pedaling or when used on the charging/exercise stand. Up to forty amps can be generated.

**MOTOR CONTROLS:** Three speed solid state/electro-mechanical system. Spring loaded safety on/off trigger switch shuts off motor when released.

**BATTERY:** Sealed, maintenance-free, lead acid twelve volt, 17 amp-hr battery is approximately 7" x 7" x 3" and weighs about 12.5 pounds.

**BATTERY CONTAINMENT:** Battery bag is a heavy duty nylon Cordura material with a large nylon zipper, and 1 inch polypropylene straps with snap-buckles.

**CHARGER:** Automatic, portable, six amp, quick charger plugs into standard electrical socket (110VAC). The maximum charging time is three hours.

**SPEEDS:** Non-pedal speeds are approximately 10/15/18 mph (180 pound rider). If you pedal, you can go faster. Lighter riders may go faster, heavier may go slower.

**RANGE:** Total range is dependent on terrain and rider input through pedaling. The standard battery is good for up to one hour of riding. (Range is typically 8-20 miles).

**WARRANTY:** One year limited. Some assembly required.

**OPTIONS:** 55 watt headlight, speedometer, exercise stand, amp hour meter. Solar panel - Charge with the sun!

### ZAP AUTHORIZED DEALER

Electric Vehicles that are fun  
117 Morris Street, Sebastopol, California 95472 USA (707) 824-4150 FAX (707) 824-4159 E-Mail: zap@nbn.com

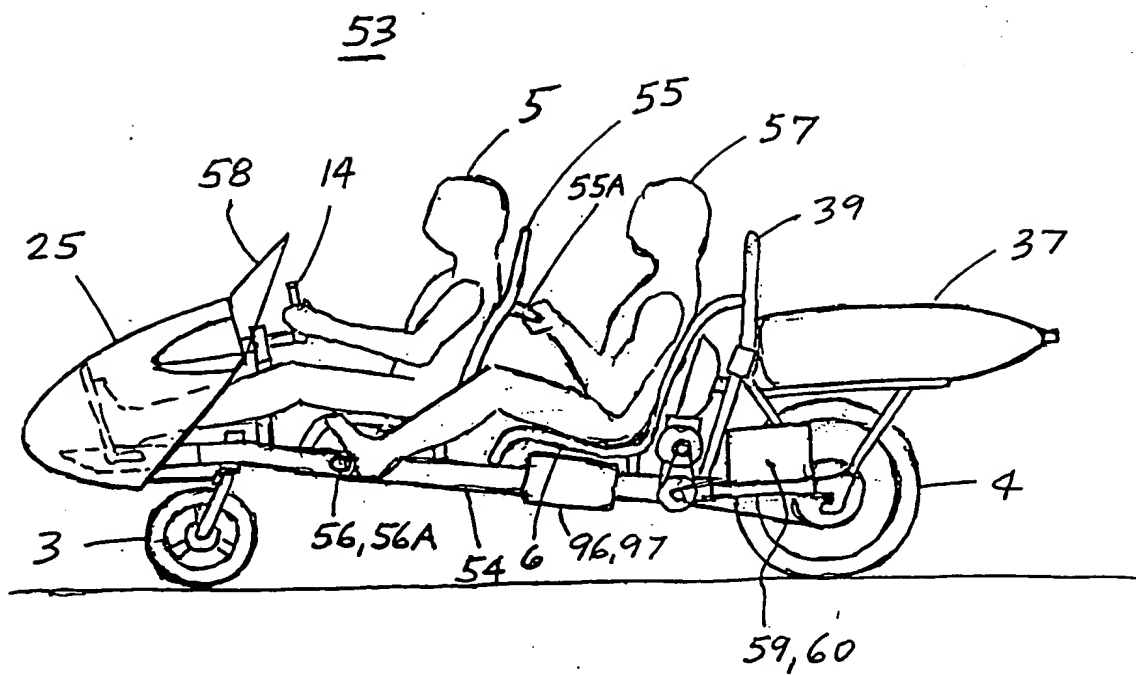


FIG. 5

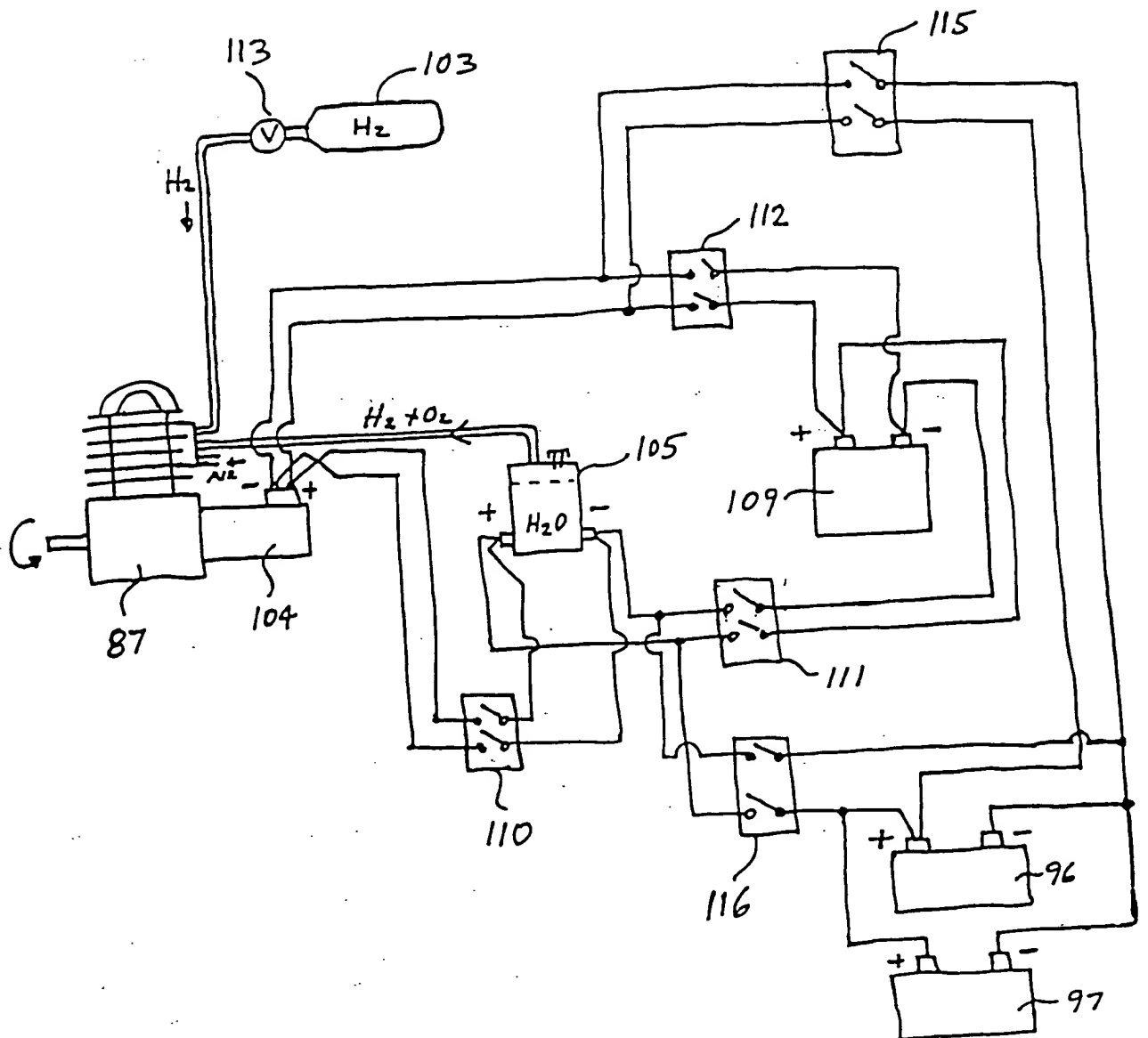


FIG. 6



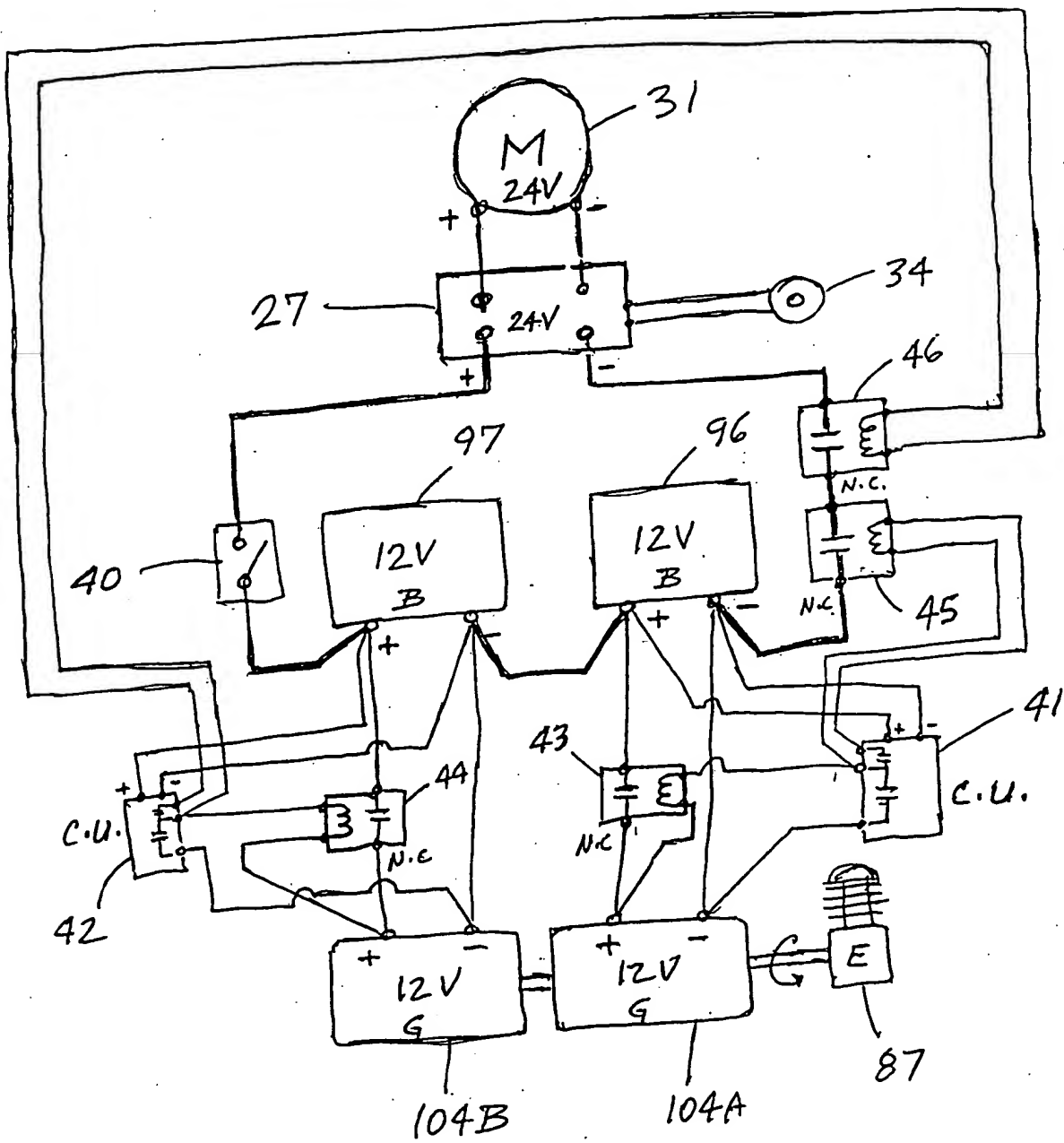
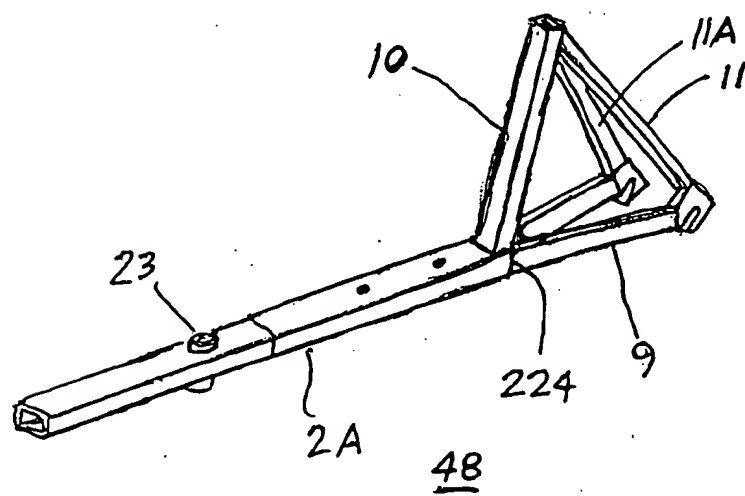
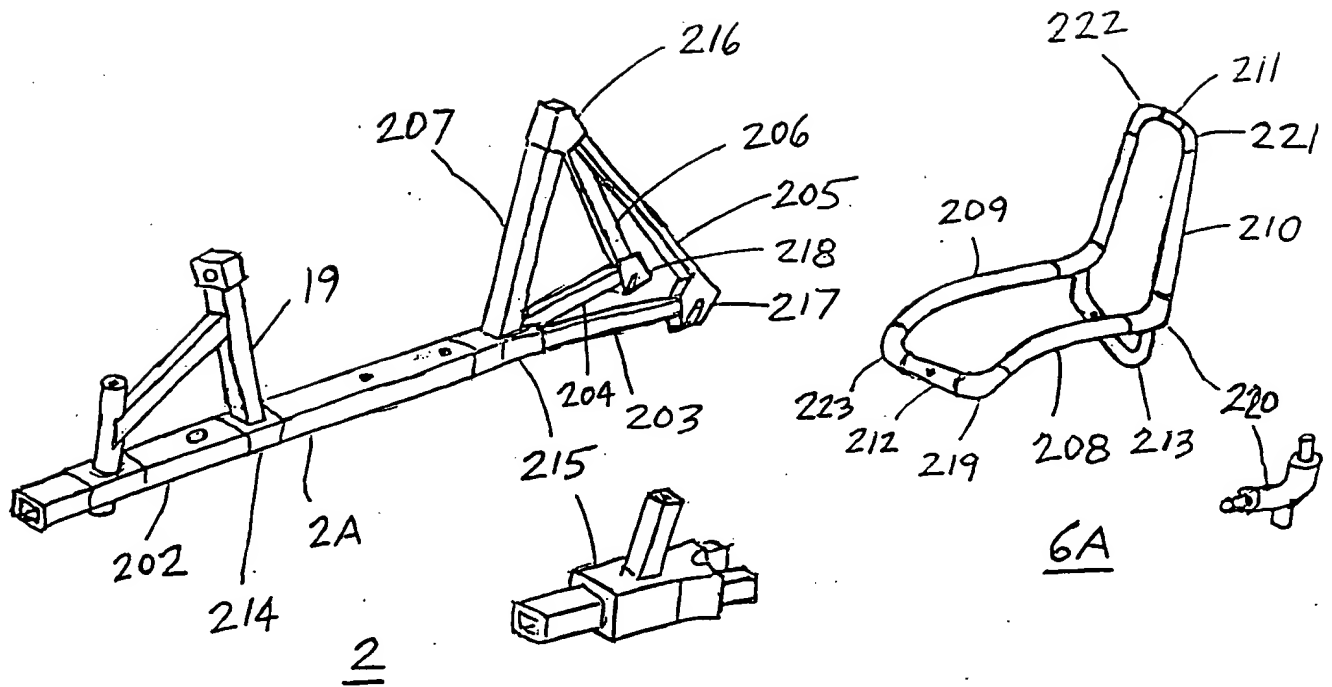


FIG. 7





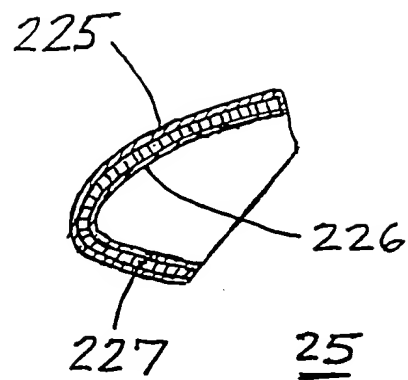


FIG. 12

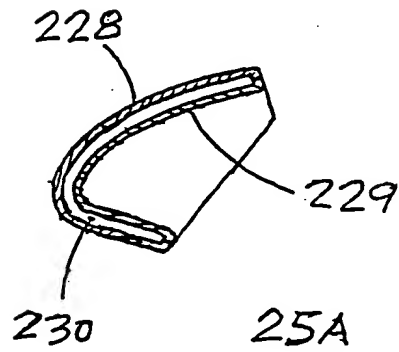


FIG. 13

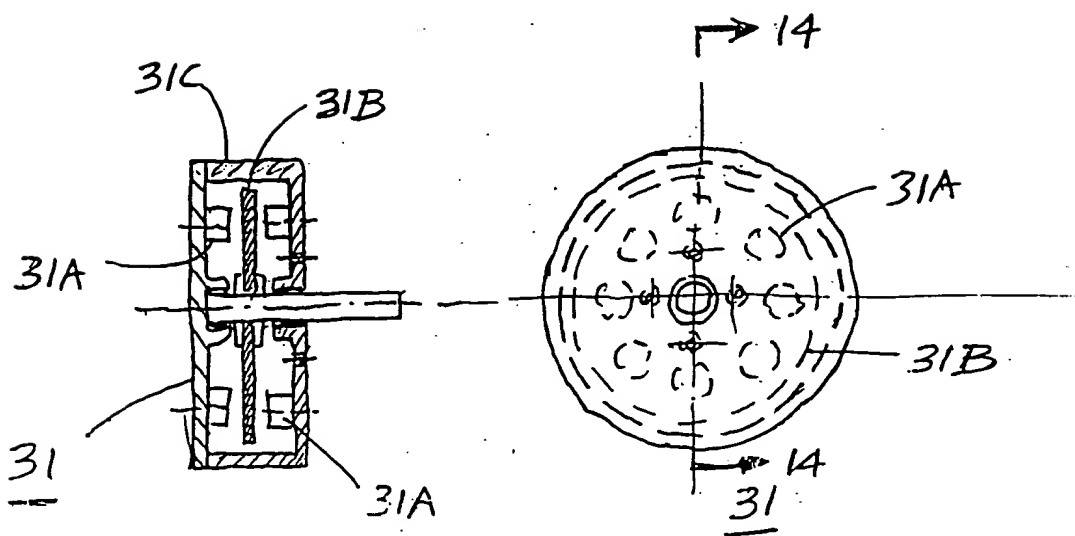


FIG. 14

FIG. 15

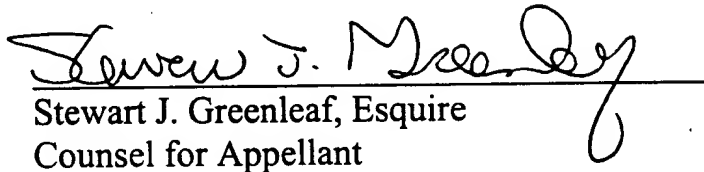
## CERTIFICATE OF SERVICE

The undersigned certifies that on this date two (2) copies of the foregoing Appellant's Brief and Addendum were served upon counsel for Appellee, in the manner and at the address indicated below:

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